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The rules of nomenclature as applied to the anopluran genus *Pedicinus* Gervais. H. E. EWING, U. S. Bureau of Entomology and Plant Quarantine.

It has been pointed out by Ferris (1934, Stanford Univ. Pub., Univ. Ser., Biol. Sci., 2 (7):34) that Gervais misidentified his type species of *Pedicinus* and that instead of having *Pediculus eurygaster* Burmeister he had what was later described by Piaget as *Pedicinus longiceps*. It has been further shown that the type species of *Phthirpedicinus* Fahrenholz, *P. micropilosus* Fahrenholz, is only a synonym of *Pedicinus eurygaster* (Burmeister). Thus the nomenclature of the genera *Pedicinus* and *Phthirpedicinus* becomes involved. In regard to what species is to be considered as the type of *Pedicinus*, Ferris states: "The view is here adopted that the type of the genus *Pedicinus* is properly that species which Gervais actually had before him and upon which he based his genus, not the species which he erroneously supposed that he had." He, therefore, makes *Pedicinus longiceps* Piaget the type of *Pedicinus*, although it was not described until many years after Gervais' genus was proposed.

The point involved, however, is covered by opinion 65 of the International Commission on Zoological Nomenclature, "Case of a Genus Based upon Erroneously Determined Species." In this opinion there is the following conclusion, "The Committee is of the opinion that as a specimen is the type of a species, so a species is the type of a genus, and hence that when an author names a particular species as the type of a new genus it is to be assumed that it has been correctly determined."

In opinion 65 the suggestion is made that in those cases where a writer specifically bases a new genus on specimens, and these specimens prove to be erroneously determined, that the matter be submitted to the commission for a decision. *Pedicinus*, however, was based on a species, not on specimens. The application of the rules of nomenclature would mean that *Pedicinus* Gervais (1844) supplants *Phthirpedicinus* Fahrenholz (1912). This transfer would leave the old generic complex, as we have come to know it, without a name, there being no subsequent synonym. The name *Eupedicinus* is here suggested for it.

Genus *Eupedicinus*, new name

With the characters of the family Pediculidae but in addition: Antennae indistinctly 5 segmented, the last 2 segments being poorly separated. Only 3 pairs of fully developed paratergal plates present on abdomen. All legs provided with subequal, slender, sharp claws.

Type species.—*Pedicinus longiceps* Piaget.

Two new pre-Columbian records of the American head louse, *Pediculus humanus americanus*. H. E. EWING, U. S. Bureau of Entomology and Plant Quarantine.

The variety *Pediculus humanus americanus* was described in 1926 by the writer from material which had been taken from the scalps of pre-Columbian American Indian mummies. The specimens represented 10 lots and included a few adults, some nymphs and many eggs. Recently 2 additional lots of pre-Columbian material have been obtained.

Mr. H. B. Collins, Jr., of the Division of Ethnology, United States National Museum, brought to the writer hair tufts taken from an old Eskimo kitchen-midden, located three-fourths of a mile east of Gambell, northwest end of St.

Lawrence Island, Alaska. According to Mr. Collins the hair samples are probably a thousand years old. The hairs from this midden were very fragile, thus interfering with the search for lice, yet the following material was obtained: One abdomen of an adult female, one thorax and an abdomen of a last nymphal instar, several eggs attached to the hairs.

An examination of the lateral tergal plates (paratergal plates), the abdominal setae and their arrangement, and the spiracular bulbs of the thorax, all indicate that these lice are typical of *Pediculus humanus americanus.*

The second new pre-Columbian record is from the scalp of a mummy of an old Indian woman which was brought to the United States National Museum by Mr. F. M. Setzler of the Division of Archeology of that institution. Mr. Setzler obtained this mummy from Goat Cave (Burial No. 1), near Deadman's Canyon, along Pecos River, Val Verde County, Texas. The head of this mummy, in a surprisingly good state of preservation, was examined, and the following louse material was obtained: One adult female, one nymph and several eggs attached to hairs. There were scores of eggs conspicuously showing on the scalp, but only a few were taken.

A study of this material from Texas shows that it is typical of the American head louse, the characteristics of which include the following: The 2nd and 5th antennal segments are each about 1½ times as long as broad; the abdominal setae are somewhat spinelike, but hardly peglike and are chiefly arranged in transverse rows; the diameter of the bulb of the thoracic spiracle is less than a tenth of a millimeter. This variety is nearest to *Pediculus humanus angustus* Fahrenholz, the oriental head louse, which in itself varies much, the forms in the Malay Region being smaller and more pigmented.

Never has the present writer encountered in his study of the lice of pre-Columbian American Indians, a type similar to that occurring commonly on Europeans or the prevailing type on African negroes. All of the specimens so far taken are very similar, and particularly so in those taxonomic characters that have been recently used to differentiate the varieties of *Pediculus humanus.*

Miscellaneous notes on cestodes. M. S. SKINKER, U. S. Bureau of Animal Industry.

(1) A correction: Through confusion in labels specimens of *Diphyllobothrium latum* collected by L. A. Woodbury were reported (1934, J. Parasitol. 19: 88) from *Euarctos ursus americanus* from the region of Salt Lake City, Utah. This host should have been given as *Euarctos americanus americanus* from Yellowstone Park, Wyoming.

(2) Meggitt (1934, J. Parasitol. 20: 181-189; fig. 1, pls. 1-5) published a description of *Oochoristica osheroffi,* n. sp., and in a table given in this paper also listed *O. americana* as a new species. Harwood had previously (1932, Proc. U. S. Natl. Mus. (2940) v. 81, Art. 17, pp. 1-71) published the description of a species for which he proposed the specific name *americana.* In correspondence with the present writer Dr. Meggitt explained that his final decision was to include the specimens which he had at first designated as "*O. americana,* n. sp." as variations within the limits of *O. osheroffi* Meggitt, 1934, therefore *O. americana* Meggitt, 1934 must be considered a synonym of *O. osheroffi* Meggitt, 1934 and not be confused with *O. americana* Harwood, 1932.

(3) In the description of *Diphyllobothrium mansonoides* Mueller, 1935, no morphological details are given which the present writer accepts as constituting adequate characters for specific differentiation of this species from *D. mansoni* (Cobbold, 1882) Faust and Wassell, 1921. *D. mansonoides* is, therefore, considered a synonym of *D. mansoni.*

(4) In the description of *Diphyllobothrium laruei* Vergeer, 1934, no morphological details are given which the present writer accepts as constituting adequate characters for specific differentiation of this species from *D. latum* (Linnaeus, 1758) Luehe, 1910. *D. laruei* is, therefore, considered a synonym of *D. latum.*

***Cephenomyia pratti* (Diptera: Oestridae) reared from blacktailed deer.** Wm. L. Jellison, U. S. Public Health Service (Contribution from the Rocky Mountain Laboratory, U. S. Public Health Service, Hamilton, Montana).

Blacktailed deer, *Odocoileus hemionus*, in western Montana are usually infested with throat bots during the spring months. In animals that have been examined immediately after death the infestations have been confined to the gutteral pouches of the throat. However, in instances where the head has been held for several hours or longer before examination, larvae are found in and emerging from the nostrils and throughout the nasal passages. Mature larvae apparently migrate through the nasal passages and are sneezed out. Pupation takes place on or in the ground.

Larvae collected in Ravalli County, Montana, as late as April 4, appeared too immature for rearing. On April 28, a collection of more than 40 bots in various stages of development (3 to 36 mm long) was made from 2 blacktailed deer of the Gird's Creek herd in the above county.

Fourteen of the largest larvae that showed very dark pigmentation of the cuticular spines were held for pupation and emergence.

The most successful rearing was accomplished with a lot of 3 larvae treated as follows: Larvae were placed in an upright glass cylinder plugged with sand at the base and partially filled with damp leaf mould. This was incubated at 4 to 7 degrees C. for 49 days with occasional wetting of the sand plug to maintain a fairly high humidity. One larva was seen to have pupated by the 4th day. The others were not visible but were later found to have pupated in a vertical position 2 to 4 inches below the surface of the leaf mould. After 49 days at low temperature the cylinder was placed at 22 degrees C. Seven days later 2 adults emerged, a male and female, and another male on the 12th day. All 3 specimens expanded their wings and hardened in excellent condition.

Of 6 larvae held at room temperature in a glass dish, 5 pupated after 4, 5, 7, 7 and 7 days, respectively. From these pupae only 1 adult emerged. Of 5 larvae held at 18 degree C. in damp shavings 2 pupated but died in the puparia.

One of the reared specimens and a male taken as adult at an elevation of 10,000 feet on Trapper's Peak, Ravalli County, were examined by the late Dr. J. M. Aldrich of the U. S. National Museum, who determined them as *Cephenomyia pratti* Hunter. He stated that the species was represented in the Museum Collection by only 3 other specimens, 2 from Sabinal, Texas, on which the original description was based and 1 from Walnut Creek, California.

The only other species of *Cephenomyia* known from North America by both larval and adult stages are *C. phobifer* and *C. trompe*. The former species has been successfully reared by Hutson (1931, Rept. Ent. Sect., Mich. State Coll. 1931) from whitetailed deer, *O. virginianus*, in Michigan and the latter has been reared from reindeer in Alaska by Hadwen and Palmer (1922, U. S. Dept. Agr. Bull. 1089).

Sand fly control in mangrove marshes. J. B. Hull and W. E. Dove, U. S. Bureau of Entomology and Plant Quarantine.

By action taken in cooperation with Norman Platts, engineer in charge, Saint Lucie Mosquito District, sand fly breeding has been stopped by diking and pumping certain experimental areas near Fort Pierce, Florida.

In these areas a dike was constructed along the edge of the river and the marsh thus protected was drained through a culvert in the dike. The culvert was fitted with an automatic tide gate and with an "impeller" type pump so as to remove water from ditches cut through the marsh above the dike and thus effectively dry out the area. The drying out of the soil destroys sand fly larvae, prevents breeding of mosquitoes, and gradually reclaims land for agricultural purposes.

Descriptions of some heterophyid trematodes of the subfamily Centrocestinae. E. W. Price, U. S. Bureau of Animal Industry.

In this paper are described three species of heterophyids belonging to the genus *Ascocotyle* Looss. Of these, two were previously described in abstract by the writer (1932, J. Parasitol., 19:166-167) and one is new. In addition, *Phagicola pithecophagicola* Faust is redescribed and refigured. A redescription of *P. pithecophagicola* seems desirable in order more clearly to demonstrate the congenerity of *Parascocotyle minuta* Stunkard and Haviland, 1921, type of *Parascocotyle*, with this form, since, as pointed out by the writer (1932, J. Parasitol., 19:88-89), some writers hesitate to accept *Phagicola* as the correct name for the genus in spite of its priority over *Parascocotyle* because of some errors in the original description of *Phagicola*.

Ascocotyle megalocephala Price, 1932

Description.—Body shaped like a tall beaker (fig. 14, A), 340 to 510μ long by 120 to 220μ wide. Anterior end as wide as maximum body width and provided with a short, ridge-like dorsal lip. Cuticula covered with minute spines. Oral aperture terminal and surrounded by a double coronet of 72 spines, 36 in each row; spines of both rows equal, 27μ long by 5μ wide. Oral sucker large and conical, with its apex at level of pharynx; acetabulum 70 to 80μ in diameter, postequatorial. Prepharynx slender, about 50μ long; pharynx 40 to 54μ long by 25 to 30μ wide; esophagus very short; intestinal ceca spacious, terminating near level of anterior margin of acetabulum. Genital aperture immediately preacetabular; genital sinus small, enclosing acetabulum. Seminal vesicle voluminous, somewhat retort-shaped, dorsal and extending to anterior margin of left testis. Testes globular, or slightly wider than long, 48 to 80μ in diameter, side by side at posterior end of body. Ovary globular, 40 to 45μ in diameter, antero-dorsal to right testis. Seminal receptacle voluminous, postero-median to ovary, its median margin closely applied to posterior end of seminal vesicle. Laurer's canal present, opening dorsally near level of anterior margin of seminal vesicle. Vitellaria lateral, extending from level of posterior margin of pharnyx to level of center of acetabulum. Uterus pretesticular, its coils extending anteriorly to level of anterior end of pharynx. Eggs 18 to 20μ long by 9 to 11μ wide.

Host.—*Butorides* sp.

Location.—Large intestine; worms occurring in closely packed groups.

Distribution.—Puerto Rico (Mayaguez). Collected by Dr. H. L. Van Volkenberg, March 24, 1931.

Specimens.—U. S. N. M. Helm. Coll. No. 40157 (type) and No. 40158 (paratypes).

This species may be easily distinguished from all other species of the genus by its peculiar shape and by the number of spines of the oral coronet. It differs also from other members of the genus in the position of the vitellaria and in the extent of the uterus anteriorly.

Sections through the oral sucker (fig. 14, B) of this species show that the sucker is a conical structure with the oral aperture situated near its ventral margin; the posterior portion is neither a cecum nor an appendix as most writers have thought, but is a muscular structure. It appears that in the genera *Ascocotyle* and *Phagicola* the oral sucker has become considerably modified from the conventional type of sucker of other digenetic trematodes and is somewhat in the nature of the anterior adhesive organ of certain gasterostomes.

Ascocotyle puertoricensis Price, 1932

Description.—Body piriform (fig. 14, C), 260 to 460μ long by 170 to 200μ wide at level of ovary. Cuticula covered with small scale-like spines arranged in alternating transverse rows and extending from just posterior to oral aperture to posterior end of body. Anterior end of body 48 to 68μ wide and provided with a triangular dorsal lip. Oral aperture terminal and surrounded by

a double coronet of 32 spines, 16 in each row; spines of anterior row 16μ long, those of posterior row 13μ long. Oral sucker elongate conical, its apex lying 1/3 to ½ the distance between oral aperture and pharynx; acetabulum about 45μ in diameter, slightly postequatorial, its cavity opening into genital sinus. Prepharynx slender, about 120μ long; pharynx 40 to 45μ long by 20 to 25μ wide; esophagus very short; intestinal ceca moderately spacious, terminating at or slightly anterior to level of genital aperture. Genital aperture median, immediately preacetabular; genital sinus relatively small; gonotyl not observed. Seminal vesicle voluminous, somewhat retort-shaped, its posterior end in contact with seminal receptacle, the 2 structures consequently appearing as a single organ in some specimens. Testes globular, 40 to 45μ in diameter, opposite each other at posterior end of body. Ovary globular, 30 to 40μ in diameter, anterior to and in field of right testis. Seminal vesicle voluminous, in median line between ovary and testes. Vitellaria lateral, extending from level of acetabulum to posterior end of body. Uterus with several convolutions, occupying greater

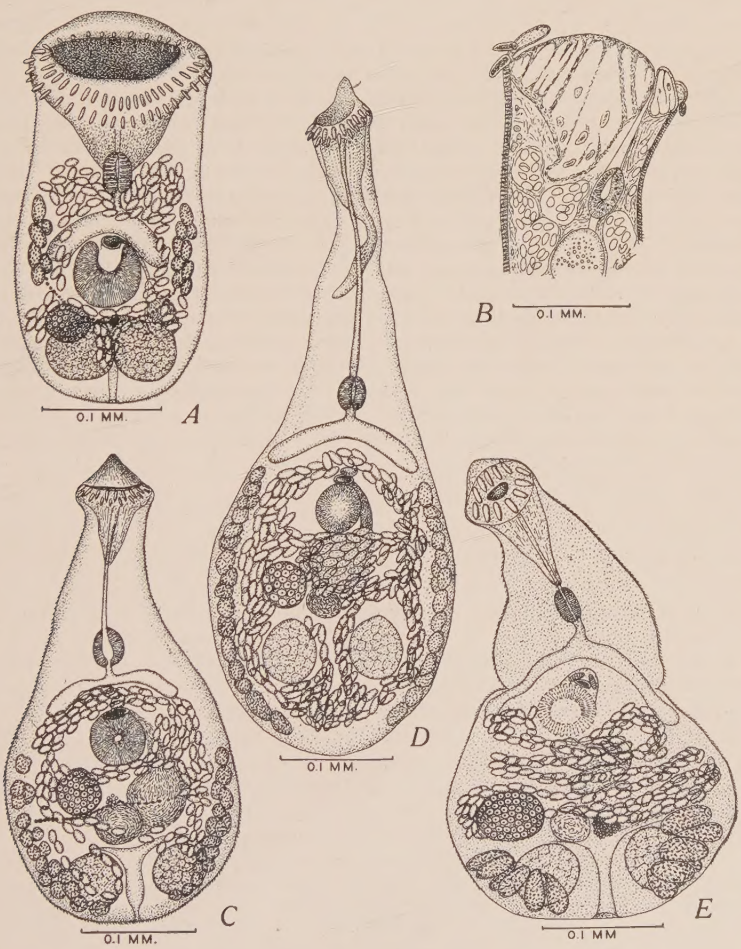

FIG. 14

A—*Ascocotyle magalocephala* Price, 1932, ventral view. B—*A megalocephala* Price, 1932, saggital section through anterior end. C—*A. puertoricensis* Price, 1932, ventral view. D—*A. tenuicollis*, n. sp., ventral view. E—*Phagicola pithecophagicola* Faust, 1920, ventral view of cotype specimen.

part of postcecal area. Eggs 18μ long by 9 to 10μ wide.

Host.—*Butorides* sp.

Location.—Large intestine.

Distribution.—Puerto Rico (Mayaguez). Collected by Dr. H. L. Van Volkenberg, March 24, 1931.

Specimens.—U. S. N. M. Helm. Coll. No. 40159 (type) and No. 40160 (paratypes).

Ascocotyle puertoricensis is the smallest species of the genus so far described. It resembles *A. coleostoma* (Looss) in the number of spines of the oral coronet, but these are somewhat larger in *A. puertoricensis.* This form differs also from *A. coleostoma* in the extent of the vitellaria posteriorly, these glands extending to the posterior end of the body in *A. puertoricensis* whereas in *A. coleostoma* they extend only as far as the anterior margin of the testes. *A. puertoricensis* resembles *A. filippei* Travassos in most respects, but may be easily distinguished from it by the number of spines of the oral coronet, there being 18 in each row in the latter and only 16 in each row in the former species.

Ascocotyle tenuicollis, new species

Description.—Body elongate piriform (fig. 14, D), 575 to 765μ long by 220 to 228μ wide at level of ovary; anterior portion of body attenuated, posterior end rounded. Anterior end 48 to 64μ wide and provided with a triangular lip. Cuticula covered with small scale-like spines. Oral aperture terminal and surrounded by a double coronet of 32 spines, 16 in each row, those of anterior row 18μ long and those of posterior row 12μ long. Oral sucker slender, conical, its apex more than ½ the distance between oral aperture and pharynx, lying dorsal to prepharynx as in other species of genus; acetabulum 40 to 60μ in diameter, postequatorial. Prepharynx 220 to 240μ long; pharynx 32 to 52μ long by 24 to 32μ wide; esophagus very short; intestinal ceca short, not extending posteriorly beyond anterior limits of vitellaria. Genital aperture immediately preacetabular; genital sinus containing a single gonotyl. Seminal vesicle large, posterior to acetabulum. Testes globular, 48 to 80μ in diameter, opposite each other, about 70μ from posterior end of body. Ovary globular, 60μ in diameter, anterior to, and in field of, right testis. Seminal receptacle globular, median, slightly postovarial. Vitellaria lateral, extending from level of genital aperture to posterior end of body. Uterus as in other species of genus. Eggs 20μ long by 10μ wide.

Host.—*Botaurus lentiginosus.*

Location.—Intestine.

Distribution.—United States. Collected by the writer at College Station, Texas, November, 1921.

Specimens.—U. S. N. M. Helm. Coll. No. 40161 (type) and No. 40162 (paratype).

Ascocotyle tenuicollis differs from *A. coleostoma* (Looss) in the extent of the vitellaria posteriorly and in the position of the testes; in *A. coleostoma* the vitellaria do not extend posterior to the anterior margin of testes and the testes are situated in the posterior end of body, while in *A. tenuicollis* the vitellaria extend to the posterior end of the body and the testes are located more anteriorly than in *A. coleostoma.* This species differs from *A. filippei* Travassos in having only 32 spines in the oral coronet, 16 in each row, while in *A. filippei* there are 36 spines in the oral coronet, 18 in each row. *A. tenuicollis* differs from *A. puertoricensis* in its larger size, extent of vitellaria anteriorly, length of posterior portion of oral sucker, and the more anterior position of the testes.

Phagicola pithecophagicola Faust, 1920

Synonyms.—*Ascocotyle pithecophagicola* (Faust, 1920) Faust and Nishigori, 1926; *Parascocotyle pithecophagicola* (Faust, 1920) Witenberg, 1929; *Ascocotyle* (*Phagicola*) *pithecophagicola* (Faust, 1920) Travassos, 1930.

Description.—Body piriform (fig. 14, E), 340 to 578μ long by 212 to 252μ wide, with triangular dorsal lip extending anterior to oral sucker. Cuticula covered with spines except at posterior end of body. Anterior end bearing a single row of 12 spines, each 20μ long. Oral sucker conical, 66 to 127μ wide, its apex lying at anterior margin of pharynx; acetabulum about 40μ in diameter, opening into genital sinus. Prepharynx slender, variable in length; pharynx 40μ long by 24μ wide; esophagus very short; intestinal ceca extending to level of posterior margin of acetabulum. Excretory aperture terminal; excretory vesicle as in other heterophyids. Genital aperture median, immediately preacetabular; genital sinus containing 2 oval gonotyls. Seminal vesicle S-shaped, extending posteriorly in median line as far as level of anterior margin of ovary; Laurer's canal not observed. Testes ovoid, 40 to 52μ long by 64 to 68μ wide, with zones coinciding and fields separate, near posterior end of body. Ovary globular to oval, 24 to 40μ long by 40 to 60μ wide, anterior to right testis. Seminal receptacle globular, median to ovary. Vitellaria lateral, each vitellarium consisting of 6 large oval follicles, in testicular zone. Uterus pretesticular, consisting of about 6 transverse loops. Eggs oval, 20μ long by 10μ wide.

Host.—Pithecophaga jefferyi (monkey-eating eagle).

Location.—Intestine.

Distribution.—Philippine Islands.

The above description is based upon the type specimens which were placed at the writer's disposal by Dr. E. C. Faust. As pointed out earlier in this paper, a number of writers have maintained the validity of *Parascocotyle* Stunkard and Haviland over the earlier *Phagicola* Faust. The above description and the figure given here should demonstrate clearly that the two genera are identical, and on the basis of priority *Phagicola* must stand as the correct name of the genus.

Travassos (1930, Mem. Inst. Oswaldo Cruz 23:61-97) regarded *Phagicola* as a subgenus of *Ascocotyle* Looss, but the writer cannot concur in this idea since there are several characters which mark the two groups as distinct. These differences are as follows: Members of the genus *Ascocotyle* have 2 rows of spines in the oral coronet; the cuticula is entirely covered with spines; the uterus extends anterior to the genital aperture; and the vitellaria extend anterior to the level of the ovary. Members of the genus *Phagicola* have only a single row of spines in the oral coronet; the cuticular spines are absent at the posterior end of the body; the uterus does not extend anterior to the genital aperture; and the vitellaria are confined to the post-ovarial region of the body.

Recently, Ciurea (1933, Arch. Roum. Path. Exp. et Microbiol. 6:1-134) has proposed a new genus and species, *Metascocotyle witenbergi*, for *Parascocotyle longa* (Ransom) of Witenberg, 1929, since in the species in question the acetabulum is completely enclosed in the genital sinus; he also included *Parascocotyle longa* (Ransom) [= *Phagicola longa* (Ransom)] in his new genus. The present writer cannot concur in this proposal for the reason that in all members of the genus *Phagicola*, as well as of the genus *Ascocotyle*, which he has been able to study, the acetabulum opens into the genital sinus in much the same manner as it does in the species mentioned by Ciurea. As to the species *longa*, described by both Ransom and Witenberg, the writer (1933, J. Parasitol. 20:111) reported finding this species in a pelican in the United States and noted that the specimens corresponded with the description of *Parascocotyle longa* as given by Witenberg (1929, Ann. Trop. Med. and Parasitol. 23:131-239). The specimens from the pelican were compared with the type specimens of *Ascocotyle longa* Ransom [= *Phagicola longa* (Ransom)] and found to be sufficiently similar to be regarded as those of the same species. In this note the writer pointed out that the material upon which Ransom based his description of *A. longa* consisted of senile specimens which showed a number of anomalies, the individual figured being one of the anomalous specimens. Consequently, the writer regards the forms described by Ransom from the United States, by Witenberg from Palestine, and by Ciurea from Roumania as representing a single species. *Metascocotyle* must, therefore, fall as a synonym of *Phagicola*, and *M. witenbergi* becomes a synonym of *Phagicola longa* (Ransom).

A new trematode, *Limatulum gastroides* (Lecithodendriidae), from the little brown bat, *Myotis lucifugus*. Ralph W. Macy, College of St. Thomas, St. Paul, Minnesota.

The new species of fluke described below was taken by the writer from the stomach of the little brown bat, *Myotis lucifugus* (LeConte), at Stockholm, Wisconsin, August 23, 1933. The average infestation was about 75 of these flukes per bat, a considerable number containing more than 200 each. Only 3 of the bats were negative for this parasite. Specimens have also been taken from the same bat at Minneapolis, Minnesota. Immature specimens have been found in the host as early as the first of May.

Limatulum gastroides, new species

Diagnosis.—Body oval, slightly flattened dorso-ventrally, from 0.54 to 0.70 mm long by 0.40 to 0.50 mm wide; integument spined. Oral sucker usually ventral, 0.08 to 0.095 mm long by 0.09 to 0.105 mm wide. Ventral sucker 0.077 to 0.09 mm long by 0.074 to 0.085 mm wide, located 0.172 to 0.20 mm from the anterior body margin. Pharynx 0.03 to 0.04 mm long by 0.04 to 0.05 mm wide. Esophagus short. Intestinal ceca short, pretesticular. Testes oblong, transverse in position, located at acetabular level, 0.087 to 0.11 mm long by 0.052 to 0.104 mm wide. Cirrus sac at right of acetabulum, distal end recurved; 0.11 to 0.132 mm long. Seminal vesicle much coiled. Genital pore between right testis and acetabulum. Ovary entire, oval, pretesticular and preacetabular, situated at left of longitudinal body axis, 0.056 to 0.086 mm long by 0.036 to 0.054 mm wide. Seminal receptacle slightly to right of ovary, variable in position, 0.035 mm by 0.014 mm in size. Laurer's canal extending anterior from seminal receptacle. Vitellaria composed of fairly large follicles, pretesticular and lateral to pharnyx and oral sucker. Uterus filling most of posttesticular zone. Eggs oval, yellowish brown, 0.019 to 0.021 mm long by 0.011 to 0.013 mm wide.

Host.—*Myotis lucifugus* (LeConte).

Location.—Stomach; to less extent, the intestine.

Distribution.—United States (Stockholm, Wisconsin, and Minneapolis, Minnesota).

Type and paratypes.—U. S. N. M. Helm. Coll.; paratypes, author's collection and University of Minnesota Helm. Coll.

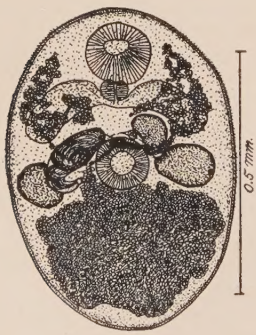

Fig. 15
Limatulum gastroides, n. sp., ventral view.

Remarks.—In this species, the average sucker diameter is about 1/6 of the average body dimension (average of length and width), while in the two other species of the genus, the suckers are larger in proportion to body size. The ventral sucker of *L. gastroides* is definitely and constantly smaller than the oral sucker, whereas the suckers of the other species are either equal to each other in size, or the ventral sucker is the larger of the two.

Travassos, 1921, redescribed *L. limatulum* (Braun, 1900) from fresh material which was taken from a Brazilian bat. According to Braun's description, the ratio between the average sucker diameter and average body diameter is 1:7; from Travassos' studies, it should be 1:4. The exact definition of *L. limatulum* will remain in doubt until Braun's type specimen can be remeasured. *L. oklahomensis* Macy, 1931, is close to *L. limatulum* as redescribed by Travassos, but differs from that species by the absence of cuticular spines.

LITERATURE CITED

BRAUN, M. 1900. Trematoden der Chiroptera. Ann. k. k. Naturh. Hofmuseum, Wien 15:217-236; pl. 10.

MACY, R. W. 1931. New bat trematodes of the genera *Plagiorchis*, *Limatulum*, and *Dicrocoelium*. J. Parasitol. 18:28-33; pl. 2.

TRAVASSOS, L. 1921. Contribuicoes para o conhecimento da fauna helmintolojica brasileira. XV. Sobre as especies brasileiras da familia Lecithodendriidae Odhner, 1911. Arch. Escola Super. Agr. Med. Vet. 5:73-79; pls. 12-16.

Maculifer chandleri, n. sp. (Allocreadiidae), a trematode from Texas catfish. PAUL D. HARWOOD, U. S. Bureau of Animal Industry.

While working at the Rice Institute, Houston, Texas, I was able to examine a number of catfish of which about a third were infested with the trematode described below.

Maculifer chandleri, new species

Description.—Body oval in outline, 2.8 to 3.85 mm long, somewhat flattened dorso-ventrally. Maximum width 0.92 to 1.09 mm. Cuticula unarmed. Oral sucker 0.3 to 0.38 mm in diameter, acetabulum 0.38 to 0.49 mm, its cephalic margin 1 to 1.44 mm from the anterior extremity. Prepharnyx about 0.1 mm long; pharynx 0.21 to 0.25 mm in diameter; esophagus about 0.2 mm long; intestinal ceca simple, reaching beyond testes practically to caudal end of body. Genital pore median, about half way between fork of intestine and cephalic margin of acetabulum, 0.84 to 1.19 mm from anterior extremity. Cirrus pouch ovoid, 0.21 to 0.34 mm long, its base lying to left of median line and just under cephalic margin of acetabulum. Cirrus unarmed; seminal vesicle somewhat convoluted, contained within pouch; pars prostatica absent. Testes tandem, adjacent, the caudal margin of caudal testis 0.56 to 0.7 mm from posterior end; cephalic testis 0.21 to 0.35 mm by 0.28 to 0.31 mm, caudal testis 0.25 to 0.36 mm by 0.21 to 0.29 mm. Ovary nearly globular, 0.18 to 0.21 mm by 0.22 by 0.25 mm, postacetabular and slightly to right. Seminal receptacle large, postovarial; Laurer's canal apparently present, but its pore not distinguished with certainty. Vitellaria in large follicles, extensively distributed, only the area anterior to middle of pharynx and the intercecal area from acetabulum to cephalic testis being without follicles. Uterus with few coils, mainly postovarial but pretesticular. Eggs few, about 95μ by 57μ, with thin yellowish shells.

FIG. 16
Maculifer chandleri, n. sp., dorsal view.

Host.—Fresh water catfish.

Location.—Intestine.

Locality.—United States (Harris Gully; Houston, Texas).

Specimens.—U. S. N. M. Helm. Coll. No. 40601 (type); No. 40602 (paratypes).

Remarks.—Apparently the chief character upon which Nicoll based his genus, *Maculifer*, was the presence of numerous pigment spots, but in trematodes of other genera pigments somewhat similar in appearance seem to have their origin in the physiological condition of the individual and, consequently, these spots are of no taxonomic importance. Further, the only species in addition to the type heretofore included in this genus lacks these spots. As these two forms and the one described herein seem to be closely related, they are included in one genus and the following generic diagnosis is based on them.

Genus *Maculifer* Nicoll, 1915

Diagnosis.—Medium-sized distomes, with smooth oval bodies. Acetabulum larger than oral sucker; intestinal ceca extending nearly to posterior tip of body. Genital pore in mid-ventral line, between acetabulum and pharynx. Cir-

rus sac large, containing a slender unarmed cirrus and convoluted seminal vesicle. Testes tandem or diagonal, postovarial but cephalic to caudal tips of ceca. Ovary nearly globular, between testes and acetabulum. Uterus of few coils, pretesticular; vitellaria of large numerous follicles covering nearly the whole body except for intercecal genital field. Eggs yellowish, thin shelled.

Type species.—*Maculifer sub-equiporus* Nicoll, 1915.

M. chandleri is the second species of the genus to be described from a fresh-water fish, the first being *Maculifer ictaluri* (Pearse, 1924) n. comb. Further study may show that it is more closely related to other forms, but because of the present confusion in the genera of the Allocreadiidae it is considered best to place it in this genus rather than to introduce still another name. I have proposed the specific name in honor of Dr. A. C. Chandler in whose laboratory I was working at the time I collected these parasites. I wish to acknowledge the helpful advice given me by Dr. E. W. Price in preparation of the manuscript. *M. chandleri* is distinguished from the other species of *Maculifer* in the following key:

1. Testes oblique; cirrus sac not reaching acetabulum ..... *M. japonicus*
   Testes tandem; cirrus sac reaching to acetabulum 2
2. Coils of uterus not extending between ovary and testes ..... *M. sub-equiporus*
   Coils of uterus extending between ovary and cephalic testis 3
3. Testes, at least caudal testis, lobed; eggs many ..... *M. ictaluri*
   Testes entire; eggs few ..... *M. chandleri*

A note on the life history of *Echinostoma coalitum* Barker and Beaver, 1915 (Trematoda: Echinostomatidae). WENDELL H. KRULL, U. S. Bureau of Animal Industry.

Experiments have been conducted to determine the life history of *Echinostoma coalitum* Barker and Beaver, 1915, a trematode common in the muskrat, *Ondatra zibethica*, in the vicinity of Beltsville, Maryland.

Eggs have been taken on repeated occasions from mature specimens of the fluke and kept in clean water until they developed and hatched. Hatching occurred in 11 to 16 days. Laboratory-raised snails, *Pseudosuccinea columella*, became infected when subjected to the attack of the miracidia. The cercariae may develop in 35 days, and are shed usually during the afternoon, although occasionally a few have been observed during the morning hours. Snails, when they are infected and ready to shed, must be watched closely for cercariae since they are, apparently, never shed in large numbers and soon reenter the snail and encyst as metacercariae. Laboratory-raised snails, *P. columella*, *Helisoma trivolvis* and *Physa halei*, as well as laboratory-raised clams, *Musculium partumeium*, have been infected with metacercariae experimentally by subjecting them to cercariae from the experimentally infected snails.

Cysts from experimentally infected snails have been fed to guinea pigs and, to date, partial development of the flukes has been obtained, the flukes having been retained by the guinea pigs for a month. Rabbits were fed cysts and the flukes matured in less than a month. Attempts to infect dogs have been made, but always with negative results.

The small cercaria of *E. coalitum* develops in a redia. Newly formed cysts of the metacercariae average 126μ in diameter, and the cyst wall averages about 8μ thick. Some of the metacercariae may grow slightly, and cysts a month or more old average 140μ in diameter.

The experiments demonstrate that the snail *Pseudosuccinea columella* may serve both as the 1st and the 2nd intermediate host; that the snails *Helisoma trivolvis* and *Physa halei*, as well as the clam *Musculium partumeium*, may serve as the 2nd intermediate hosts for this fluke; that partial development of the fluke in a definitive host may be obtained by using guinea pigs; and that the flukes mature in rabbits. Further details of the life history will be given in a subsequent paper.

***Glaphyrostomum mcintoshi*, n. sp. (Trematoda: Brachylaemidae), with notes on its life history.** WENDELL H. KRULL, U. S. Bureau of Animal Industry.

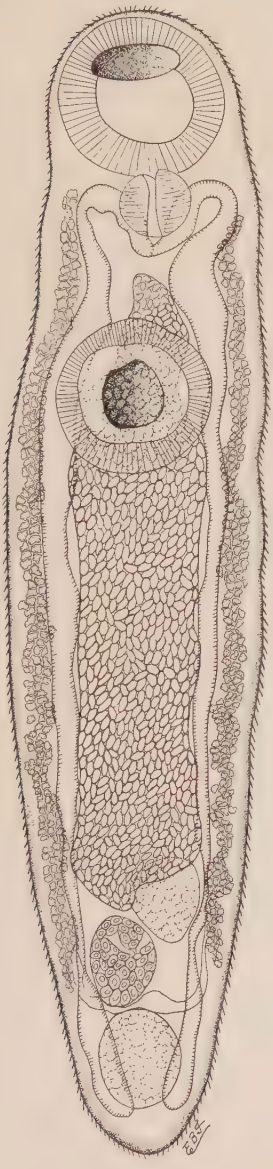

FIG. 17

Glaphyrostomum mcintoshi, n. sp., ventral view.

Glaphyrostomum mcintoshi, n. sp. (fig. 17) was taken originally from an oven-bird, *Seiurus aurocapillus* (Linn.), at Beltsville, Maryland, and subsequently very young chickens have been infected experimentally. The following description is based on 45 specimens, 2 taken from the oven-bird and 43 from chickens.

Body 950μ to 2.2 mm long by 280 to 330μ wide. Cuticular spines present ventrally and at ends of body dorsally. Suckers well developed, oral larger, diameter 188 to 270μ, than acetabulum, diameter 170 to 255μ. Mouth opening transverse; pharynx large, 75 to 130μ wide; ceca extending to posterior end of body. Excretory pore dorsal, near posterior end of body. Relative size of testes to ovary variable; testes round to oval, usually smaller but sometimes approaching ovary in size. Ovary round to oval, 115 to 205μ long by 90 to 168μ wide. Laurer's canal present, opening dorsally at level of mid-ovary; genital pore opening ventrally in field of ovary. Vitellaria extending anteriorly from a level midway between pharynx and acetabulum to mid-pharynx, and extending posteriorly to a level from middle of ovary to middle of posterior testis. Uterus intercecal, extending anteriorly to a level from mid-acetabulum to halfway between oral sucker and acetabulum, never voluminous in this region, and extending posteriorly as far as anterior border of anterior testis or, usually, somewhat beyond this level. Eggs averaging 24μ long by 15μ wide in stained and mounted specimens and 27μ by 15μ in living specimens.

G. mcintoshi is closely related to *G. sanguinolentum* Werby, 1928; it differs from the latter species in having a cuticula which is partially spined, vitellaria which extend farther anteriorly, and in the absence of a prominent papilla bearing the genital pore.

Eggs from 1 of the 2 specimens of *G. mcintoshi* taken from the oven-bird were used to infect laboratory-raised snails, *Zonitoides arboreus*. The cercariaeum of *G. macintoshi* develops in a branching sporocyst and grows in size to become an infective larva; the larvae do not leave the sporocyst and do not encyst. The ceca of the infective larvae are filled with brownish material even though the larvae remain in the sporocyst. Snails with fully developed larvae were kept for about 7 months. A complete description of the life history will be given in a later paper.

Observations on the life history of *Macravestibulum obtusicaudum* Mackin, 1930 (Trematoda: Pronocephalidae). Margery W. Horsfall, U. S. Bureau of Animal Industry (Contribution from the Zoological Laboratory of the University of Illinois, No. 471).

By means of experimental infection, the author has demonstrated that *Cercaria infracaudata* Horsfall, 1930 (J. Parasitol. 17:43-48) develops into *Macravestibulum obtusicaudum* Mackin, 1930 (J. Parasitol. 17:25-29), a member of the Pronocephalidae, parasitic in the duodenum of fresh-water turtles. The cercaria has been found in *Goniobasis livescens* from the Vermilion River system, Illinois, and the adults in *Pseudemys elegans* [now *P. troosti*, according to Viosca (Copeia 1933:208-210)] from Blue River near Connerville, Oklahoma, and in *Pseudemys concinna*, *P. troosti*, *Graptemys geographica* and *G. pseudogeographica* from Reelfoot Lake, Tennessee. The author has never been able to examine turtles from the Vermilion River nor snails from Reelfoot Lake so a complete life history has not been demonstrated in one place. Through experimental infection, a few specimens of *M. obtusicaudum* developed to maturity in meat-fed turtles but work was interrupted before experiments on a vegetarian diet were completed. Attempts to infect *Amyda spinifera*, *Sternotherus odoratus*, *Chelydra serpentina* and *Chrysemys marginata* were unsuccessful. Both immature and mature worms were found in turtles from Reelfoot Lake in April, 1933, and April, 1934, the only time of the year that the hosts were available, but the cercariae in the Vermilion River were found during the entire year.

The cercariae encysted upon the outside of the operculum of any convenient snail or on any hard surface but not on vegetation. The cysts were irregularly spherical, approximately 0.35 mm in diameter. No apparent organ development was found in this stage. When the cysts were fed to turtles, the worms reached maturity in approximately 60 days. During early development in the turtle, the middle eye spot of the cercaria, which formed last and seemed to be only a mass of disorganized pigmented tissue, broke up and disappeared. The 2 lateral eyespots persisted until the eggs started to form, but usually disappeared between the 30th and 50th days. Developing worms frequently exhibited a peculiar behavior. The immature worm fastened itself to the substratum by its sucker and concave ventral surface, evaginated the vestibular cavity, and slowly waved the posterior end of the body back and forth (fig. 18). The body which was encircled by folds or creases due to the vestibular evagination bore a superficial resemblance to certain members of the Hemiuridae. Any sudden change caused invagination of the vestibule and the worm assumed its more typical appearance. This reaction lasted for only a few hours after removal from the host. The author could not attach any significance to this behavior, and sectioned specimens gave no clue to its cause.

Fig. 18
Macravestibulum obtusicaudum, immature.

Only 3 of the adult structures need discussion beyond that previously given. Three small gland-like bodies were present in the cirrus pouch, each of which contained a circular lumen from which a small duct led into the ductus ejaculatorius. These structures were visible but inconspicuous in Mackin's specimens which the author studied in 1933. On either side immediately anterior to the 2 lateral arms of the vestibular cavity, the excretory bladder was irregularly folded and here the collecting tubes joined the bladder. During evagination of the vestibule, the folded region of the excretory bladder was lengthened thereby

allowing the bladder to reach the posterior end of the body. Mackin (1930) did not find any connection between the excretory bladder and the vestibule which gave the impression that there was no outlet for the excretory system. In thin sections the author was able to demonstrate 3 to 6 tiny ducts leading posteriad from the most posterior median part of the bladder to the vestibule.

The most conspicuous and characteristic structure of this monostome was the large vestibule which was better developed than in other members of this family. Study of the worms during development showed that the vestibule was capable of a variety of shapes and positions, of which the most characteristic is the "Rippentrichter" discussed by Looss (1902, Zool. Jahrb. Syst. 16:411-894). Specimens of both cercaria and adult are deposited in the United States National Museum under Nos. 42037—42039.

A progenetic metacercaria of a *Clinostomum* in a West Indian land snail. Allen McIntosh, U. S. Bureau of Animal Industry.

In March of 1935, Dr. H. L. Van Volkenberg, Parasitologist of the Puerto Rico Agricultural Experiment Station, forwarded to the Zoological Division of the U. S. Bureau of Animal Industry for identification several specimens of a species of trematode that had been collected from land snails. The worms were examined by the writer and found to be a species of *Clinostomum* closely related to, if not identical with, the species known in America as *C. marginatum*, a parasite of herons and other birds of similar habits. The majority of the specimens resemble, except for smaller size, the metacercarial stage of the *Clinostomum* commonly found encysted in fish. Two of the specimens were sexually mature or approaching maturity; a well-developed protrusible cirrus was present in each of these specimens, and the uterus of one of them was filled with eggs. Insofar as the writer is aware, this is the first record of the occurrence of a *Clinostomum* in a land snail. It is especially interesting that these flukes should reach sexual maturity in snails. There are several records of flukes of fishes and also of amphibians, reaching sexual maturity in arthropods, e. g., crayfish, mayflies, etc., and recently R.-Ph. Dollfus (1932, Ann. Parasitol. 10:407-413) has reported what is apparently a reptilian parasite (*Distoma cloacicola* Luehe, 1909) as reaching sexual maturity in a fresh water snail (*Planorbis planorbis*) but, so far as the writer is aware, this is the first record of a trematode of a warm-blooded animal reaching sexual maturity in a snail. For such cases of precocious development Dollfus has introduced the term "metacercaire progenetique." Do these records of precocious development throw light on what the adult flukes were like in the ages before the vertebrates came into being, or may the phenomenon be explained on the basis of the similarity of the environment of the metacercaria with that of the habitat of the adult? Conceivably, forms that live as metacercariae in aquatic arthropods and as adults in aquatic cold-blooded vertebrates might find the environment of the two different abodes so near alike, especially as regard temperature, that in the event the metacercaria was delayed in being transferred to the definitive host, sexually developed forms would result. But would this apply to such forms as *Clinostomum* in which the adult fluke normally develops in a warm-blooded animal with a very high temperature, such as a bird? The answer might possibly be that the temperature of the land snails in Puerto Rico was so nearly equal to that found in the mouth of a bird that at least a few metacercariae (which had found their way into a land snail as cercariae) were able to continue their development to sexual maturity in the snail.

Specimens of these snails were obtained from Dr. Van Volkenberg, during the month of May, for identification and for further examination for parasites. These snails were identified as *Subulina octona* by Dr. Harald A. Rehder, Division of Mollusks, U. S. National Museum. In 3 of 75 snails examined, a larval fluke was found, but the specimens were too immature to be recognized as a

species of *Clinostomum*. In certain respects they resembled brachylaemids and may have been members of that family, as *Postharmostomum gallinum* Witenberg is known to occur in chickens in the region where the snails were collected. Two of the 3 specimens were fed to a 6-week-old chick, but on examination 4 days later they were not recovered.

New host records of parasites. Allen McIntosh, U. S. Bureau of Animal Industry.

Haptophrya michiganensis Woodhead, 1928 (J. Parasitol. 14:177-182), was originally reported from *Hemidactylium scutatum* (Schlegel) and *Ambystoma jeffersonianum* (Green). On June 29, 1928, the writer found this very interesting astomatous protozoan in the small intestine of a giant specimen of *Bufo americanus* Holbrook, this toad being collected near the north shore of the east end of Douglas Lake, Michigan. On April 27, 1935, this parasite was again found by the writer in a specimen of *Rana pipiens* Schreber collected near the Potomac River at Great Falls, Maryland.

Scaphiostomum pancreaticum McIntosh, 1934 (Proc. Helminth. Soc. Wash. 1:2-4), originally reported from *Tamias striatus lysteri* (Richardson), was found by Mr. E. V. Komarek on December 2, 1934, in a specimen of *Peromyscus g. gossypinus* (LeConte), captured in the Okefenokee Swamp, Georgia. This parasite was identified from a fragment of a specimen forwarded to the Zoological Division, along with some other parasites for identification.

Collyriclum faba (Bremser), a cutaneous trematode parasite of several species of European birds and reported as a parasite of turkeys, chickens, and robins in Minnesota by Dr. Wm. A. Riley, was found by the writer in a flock of crows at the University of Michigan Biological Station, Douglas Lake, Michigan. The occurrence of this parasite in crows was first observed in 3 fledglings collected just east of the biological station on June 28, 1928. On July 14, 1928, another young bird from a locality west of the station and probably from the same flock was also found to be heavily parasitized with this fluke. In July 18-26, 1929, 4 birds, 3 birds of the year and 1 adult, were found infested with this parasite. The adult bird, taken by Dr. F. N. Blanchard, was reported as appearing sick when shot. The fledglings taken in June each harbored approximately 250 cysts about the vent. Many of the cysts were small, each containing 2 small immature flukes. Eggs at this time were being shed from the cysts containing mature flukes. All cysts observed in detail contained 2 flukes of approximately equal size. The young birds taken in the latter part of July and also the adult bird had fewer cysts than the fledglings examined in June, which suggests the possibility of a gradual loss of the infestation. Probably all of the birds found parasitized over the 2 years mentioned were from the same flock of crows, one that had nested in that locality for years. Two additional crows, an adult from the Pelliston locality, and a bird of the year from the Monro Lake locality, were negative. Although the incidence of records of hosts examined are too few for any general conclusions, it appears from the available data that the presence of this parasite in crows may have been confined to a single flock. In addition to the findings in the crow, this parasite was found by the writer in only one other bird of several species examined from this locality. On July 2, 1928, 2 white-breasted nuthatches, *Sitta c. carolinensis* Latham, from the north shore of Douglas Lake, were examined for parasites, and 2 cysts with immature *Collyriclum faba* were found on one of the birds just above the vent.

A new coccidium, *Eimeria halli*, n. sp., in rats. W. L. YAKIMOFF, Laboratory of Parasitology, Veterinary School, Leningrad, U. S. S. R.

At present 3 species of coccidia are known from rats, namely *Eimeria miyairii* Ohira, 1912 (=*E. nieschulzi* Dieben, 1924), *E. carinii* Pinto, 1928, and *E. separata* Becker & Hall, 1931. These are not described at this point as their diagnostic characters are given in table 2. What we regard as a new species was found under the following circumstances:

During July, 1934, one of my pupils, Motschulsky, was examining the feces of pigs in Leningrad and found the following species of coccidia: *Eimeria debliecki* Douwes, 1921, *E. scabra* Henry, 1931, and *E. perminuta* Henry, 1931. Simultaneously he examined the feces of several grey rats, which rats were numerous in the pig sty, and found *E. debliecki* in these also. On July 19 he brought to our laboratory some rat feces found on the floor of the pig sty, and when these were examined by Darling's method they showed a great quantity of oocysts which differ from all previously known species of coccidian oocysts found in pigs. The oocysts found had the following characters:

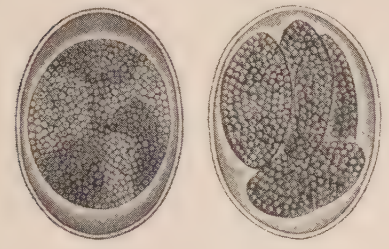

FIG. 19
Eimeria halli, n. sp., oocysts.

Oocysts (fig. 19) mostly oval, more rarely subspherical, and very rarely spherical; yellowish in color. No micropyle seen. Protoplasm coarsely granular as a rule, either present throughout entire oocyst or collected in a ball. Envelope 1.8μ thick. Oocysts (100 measured) 18 to 32.4μ long by 12.6 to 21.6μ wide, averaging 24μ by 17.2μ; maximum-sized specimens, 32.4μ by 18μ; minimum-sized specimens, 18μ by 12.6μ; most common measurements, 23.4μ by 18μ. Shape index, 1: 0.51-0.90; average, 1:0.76; most frequently 1:0.76. The figure indicates that the oocysts of the greatest length almost double the minimum width.

The much less common subspherical forms had the following dimensions: 14 to 27μ by 12.6 to 24.3μ; maximum-sized specimens, 27μ by 24.3μ; minimum-sized specimens, 14.4μ by 12.6μ. Shape index, 1:0.81-0.91. The rare spherical forms were 18 to 19.8μ in diameter. Oocysts without residual bodies or polar granules. Sporocysts with residual bodies. Oocysts with 4 spores each, each spore containing 2 sporozoites. The relative sizes of oocysts and spores are as follows:

Oocysts	Spores
19.8μ by 18μ	10.8μ by 6.5μ
20.7μ by 18μ	14.4μ by 7.2μ
21.6μ by 18μ	10.8μ by 6.3μ
21.6μ by 18μ	12.6μ by 7.2μ
23.4μ by 17.1μ	12.6μ by 7.2μ

A comparison of this coccidium with the previously known coccidia from pigs, is given in table 1. The table indicates that our coccidium does not greatly resemble any previously described species of coccidia from pigs, either in external appearance or in size.

TABLE 1

	E. debliecki	*E. scabra*	*E. perminuta*	*E. spinosa*	*Eimeria halli* n. sp.
Shape	Oviform	Elliptic, oviform	Oval, spherical	Oviform, elliptic	Oval, subspherical
Character of wall	Colorless to brownish; smooth	Brown, roughened, with thickened areas	Yellowish, roughened	Brown, surface spiny	Yellowish, smooth
Size	12.8-28.8μ x 12.8-19.2μ	22.4-35.6μ x 16-25.6μ	11.2-16μ x 9.6-12.8μ	16-22.4μ x 12.8-16μ	18-32.4μ x 12.6-21.6μ

TABLE 2

Species	Country	Oocyst: Shape	Oocyst: Membrane	Oocyst: length	Oocyst: width	Oocyst: Average size	Residual bodies: in oocyst	Residual bodies: in sporocyst	Polar granules	Shape index: from	Shape index: to	Authors
Eimeria miyairii	U. S. A.	Oviform, tapering toward both ends	Smooth or granular	16.2-26.4μ	13.4-21.3μ	22.5x17.8μ	0	+	0			
	Russia	Oval		14.4-24.3μ	10.2-19.8μ	17.4x14.9μ	0	+		0.66	0.95	Yakimoff and Gouseff, 1932
		Oviform		21.6-23.4μ	16.2-19.8μ	17.4x14.9μ				0.72	0.84	
Eimeria nieschulzi (=*E. miyairii*)	Holland	Oval, sometimes oviform		18-26μ	14-20μ		0	+	0	0.67	1.0	Dieben, 1924
Eimeria separata	U. S. A.	Elliptic, sometimes oviform or spherical	Smooth	12.8-19.11μ	11.2-17.2μ	16.06x13.85μ	0	+	+			Becker and Hall, 1931
	Russia	Oval	Smooth	15-19.5μ	12-16.5μ	17.7x14.9μ			?	0.69	0.91	Yakimoff and Gouseff, 1934
	Leningrad	Spherical	Smooth	11.7-18μ		15μ						
	Witebsk	Spherical	Smooth	13-18μ		17.1μ						
Eimeria carinii	Brazil	Subspherical and spherical	Radial	16.8-29μ	16.1-26μ	24.38x22.12μ	0	+				Pinto, 1928
Eimeria halli, n.sp.	Russia	Oval, sometimes subspherical or spherical	Smooth	(Oval) 18-32.4μ	12.6-21.6μ	24x17.2μ	0	+	0	0.51	0.90	The present paper
				(Subspherical) 14-27μ	12.5-24.3μ					0.81	0.91	
				(Spherical) 18-19.8μ								

A comparison of this species from rats with the previously described coccidia from rats is given in table 2. From this table it appears that our form does not resemble any of the previously described coccidia from rats.

We regard the coccidium described here as a new species, and name it *Eimeria halli*, n. sp., after the well known American parasitologist, Dr. Maurice Hall.

REFERENCES

BECKER, E. R., and HALL, P. 1931. *Eimeria separata*, a new species of coccidium from the Norway rat (*Epimys norvegicus*). Iowa State Coll. J. Sci. 6 (1):131.

DIEBEN, C. P. A. 1924. Over de morphologie en biologie van het rattencoccidium *Eimeria nieschulzi* n. sp. en zijne verschpreiding in Nederland. Proefschrift. Utrecht.

OHIRA, [TOKUZO]. 1912. Ein Beitrag zur Coccidiumforschung. Ueber ein bei Ratten gefundenes Coccidium (*Eimeria miyairii*). Mitt. Med. Gesell. Tokio (n. F. 17) 26:1-10.

Parasites of cattle in Costa Rica. G. DIKMANS, U. S. Bureau of Animal Industry.

The Bureau of Animal Industry recently received for identification some nematode and cestode parasites collected from cattle in Costa Rica by Sr. Carlos Viquez, San José, Costa Rica. The nematodes were identified as *Setaria labiato-papillosa* and *Mecistocirrus digitatus*, and the cestodes as *Moniezia benedeni*.

Mecistocirrus digitatus has been reported as a parasite of cattle, goats and swine in Asia but has not been reported from the Western Hemisphere. This report is of interest because it is the third occurrence within a year of parasitic nematode genera from domestic ruminants in the Western Hemisphere, previously reported only from ruminants in Asia. Two of these, *Elaeophora* and *Stephanofilaria*, have been found in the United States and one, *Mecistocirrus*, in Central America.

New records of nematode parasites from deer in the United States. G. DIKMANS and JOHN T. LUCKER, U. S. Bureau of Animal Industry.

(1) *Gongylonema verrucosum from the rumen of a deer, Odocoileus virginianus, from the Ocala National Forest, Florida.*—Mr. W. M. Rush of the Forest Service recently submitted to the Bureau of Animal Industry for examination some nematodes collected from the rumen of a deer at Ocala, Florida. These nematodes were recognized as *Gongylonema* and were identified by one of us (J. T. L.) as *Gongylonema verrucosum*. Mönnig (1934, Veterinary Helminthology and Entomology, 402 pp. Lond.) states that this nematode is a parasite of goats, sheep, cattle and zebu in India and South Africa, but apparently overlooked the fact that it was reported from sheep and goats in Texas by Price (1927, J. Parasitol. 14:54). There appears to be no previous record of its occurrence in deer.

(2) *Gongylonema pulchrum from the esophagus and tongue of deer, Odocoileus virginianus, in North Carolina.*—In the last two years the Bureau of Animal Industry has received from Dr. J. E. Shillinger, Bureau of Biological Survey, two lots of nematodes collected from the esophagus and tongue of deer in North Carolina. These nematodes were identified by one of us (J. T. L.) as *Gongylonema pulchrum*. There are only two previous records of the occurence of *Gongylonema pulchrum* in deer, and in both cases the identification was made on the basis of female specimens only, no male *Gongylonema* apparently having been reported from deer since Molin (1857, Atti R. Ist. Veneto Sci., Lett. ed Arti, Venezia (1856-57) (3.s) 2:146-152) reported *Gongylonema spirale* from *Cervus dama*. Male specimens were present in the material from North Carolina.

A note on the identity of *Cooperia punctata* Ransom, 1907, and *C. fieldingi* Baylis, 1928 (Nematoda: Trichostrongylidae). G. Dikmans, U. S. Bureau of Animal Industry.

In 1928, Baylis described as new species 2 species of *Cooperia, C. nicolli* and *C. fieldingi,* from calves in Australia. In 1932, I presented a note to the Society in which I synonomized *Cooperia nicolli* and *C. pectinata,* leaving *Cooperia fieldingi* as a new species in spite of the fact that, except for size, the spicules of *C. fieldingi* were morphologically identical with the spicules of *C. punctata.*

A short time ago, Dr. H. L. Volkenberg sent to the Bureau of Animal Industry some nematodes collected from cattle in Puerto Rico. Among these were a number of specimens of *Cooperia* which on examination were identified as *C. punctata.* Ransom gave the spicule length of *C. punctata* as 120 to 150μ. Baylis stated that in *C. fieldingi* the length of the spicules varied from 187 to 235μ. In 16 male specimens of *C. punctata* collected from cattle in Puerto Rico, the length of the spicules varied from 130 to 195μ. In 25 other male specimens selected at random from collections made from cattle in Louisiana, Florida and Virginia, the length of the spicules varied from 112 to 176μ. This indicates that the length of the spicules varies considerably in this species, and while the maximum length of spicules given for *C. fieldingi* has not been observed in any specimens of *C. punctata* there is an evident overlapping in the length of the spicules in these 2 nematodes as may be seen from the figures cited above. Since the spicules of *C. fieldingi* are morphologically identical with those of *C. punctata* the writer agrees with LeRoux (1930) that these 2 nematodes are identical. *C. fieldingi,* therefore, becomes a synonym of *C. punctata.*

A note on *Protostrongylus stilesi* (Nematoda: Metastrongylidae) from the mountain sheep, *Ovis canadensis,* in Yellowstone National Park, Wyoming. G. Dikmans, U. S. Bureau of Animal Industry.

This nematode, which has previously been reported from mountain sheep in Colorado, was recently found in a lung of a mountain sheep from the Yellowstone National Park, Wyoming, sent to the Bureau of Animal Industry for examination. No entire specimens were collected from the Colorado material, but 3 entire male specimens were recovered from the Wyoming material. The length of these male specimens varied from 17 to 20 mm.

A revised classification of the nematode superfamily Filarioidea. Everett E. Wehr, U. S. Bureau of Animal Industry.

The writer has for several years been making a monographic study of the filarioid nematodes, a task which has been unavoidably slow because of the necessity of acquiring an acquaintance with as many members of this group as possible and the difficulty in finding suitable diagnostic characters for use in a classification. The classification presented in this paper is based on this study. The adoption of the cephalic papillae pattern, the labial structures and the characters of the first-stage larva in the present revised classification is a deviation from the general practice of most present day systematists who, like their predecessors, have adopted almost exclusively adult body structures only as a basis of classification. First-stage larval characters have been much stressed in the following classification as differential characters for the major groups.

Superfamily FILARIOIDEA (Weinland, 1858) Stiles, 1907

Synonyms.—Filarioidea Weinland, 1858 (family); Filaroidea Sprehn, 1927.
Diagnosis.—Spirurata: Oral opening circular or dorso-ventrally elongated.

Circumoral elevation and circumoral membrane present or absent. Cephalic papillae consisting of an external circle of 8, and an internal circle of 2, 4, or none. True lips and pseudolabia absent. Buccal cavity usually greatly reduced or rudimentary. Vulva usually near anterior end of body. Oviparous or viviparous.

Key to families of Filarioidea

1. Oral opening surrounded by a row of small spines.....Stephanofilariidae
   Oral opening not surrounded by a row of small spines..... 2
2. Buccal cavity well developed, subcylindrical, with lateral cuticular projections at anterior end.....Desmidocercidae
   Buccal cavity rarely well developed, never subcylindrical, never with lateral cuticular projections at anterior end..... 3
3. Esophagus usually divided externally into anterior muscular part and posterior glandular part; first-stage larva usually short and stout, rarely long and slender, its anterior end always surrounded by a number of rows of spines, and its posterior end, if short and blunt, surrounded by 1 row of spines.....Filariidae
   Esophagus usually not divided externally into anterior muscular part and posterior glandular part; first-stage larva never short and stout, its extremities never with spines.....Dipetalonematidae

Family FILARIIDAE Claus, 1885

Synonyms.—Filariadae Baird, 1853; Filaridea Carus, 1863; Filaridae Cobbold, 1864; Filarides Assenova, 1899.

Diagnosis.—Filarioidea: Oral opening dorso-ventrally elongated or circular, sometimes surrounded by 4 conoid pseudo-lips. Internal trident-like and superficial epaulette-like cuticular formations occasionally present. Cuticle lateral to oral opening usually raised in form of tooth-like projections. Circumoral elevation and circumoral membrane often present. Internal circle of papillae, except for internolaterals, usually absent. Esophagus usually divided externally into anterior short, narrow, muscular portion and posterior long, broad, glandular portion. Caudal alae present or absent. Oviparous or viviparous; if oviparous, eggs with thick shells. First-stage larva usually short and stout; anterior end broad, surrounded by several rows of posteriorly directed spines, posterior end long and pointed, or short and bluntly rounded; if bluntly rounded, surrounded by a single row of spines.

Type genus.—*Filaria* Mueller, 1787.

Key to subfamilies of Filariidae

1. Oral opening surrounded by 4 pseudo-lips.....Tetracheilonematinae
   Oral opening not surrounded by lips..... 2
2. Cuticular trident-like structures present, located lateral to anterior end of esophagus ..... Diplotriaeninae
   Cuticular trident-like structures absent..... 3
3. Cuticle lateral to oral opening raised in form of tooth-like projections, or thickened to form epaulette-like formations, or both.....Dicheilonematinae
   Cuticle lateral to oral opening not as above..... 4
4. Vulva very close to oral opening.....Filariinae
   Vulva at considerable distance posterior to oral opening.....Aproctinae

Subfamily FILARIINAE Stiles, 1907

Diagnosis.—Filariidae: Oral opening circular. Lateral alae present or absent. Internal papillae (internolaterals only) present in at least some forms (*Filaria*). Caudal alae present or absent. Spicules unequal and dissimilar. Vulva very close to oral opening.

Type genus.—*Filaria* Mueller, 1787.

Other genus.—*Parafilaria* Yorke and Maplestone, 1926.

Dicheilonematinae, new subfamily

Synonym.—*Setariinae* Yorke and Maplestone, 1926.

Diagnosis.—Filariidae: Oral opening usually dorso-ventrally elongated. Superficial epaulette-like cuticular formations present or absent. Circumoral elevation and circumoral membrane present or absent. Internal circle of papillae, if present, represented by internolaterals only. Esophagus divided externally into anterior short, narrow, muscular part and posterior long, broad, glandular part. Spicules unequal and dissimilar. Caudal alae usually present. First-stage larva usually short and stout, with anterior end surrounded by a number of rows of spines.

Type genus.—*Dicheilonema* Diesing, 1861 (Syn.—*Contortospiculum* Skrjabin, 1915).

Other genera.—*Hamatospiculum* Skrjabin, 1916 (Syns.—*Hastospiculum* Skrjabin, 1923; *Parhamatospiculum* Skrjabin and Petrow, 1928); *Monopetalonema* Diesing, 1861 (Syns.—*Monopelalonema* Hunter and Hunter, 1932, missp.; *Ornithosetaria* Sandground, 1933; *Politospiculum* Skrjabin, 1916); *Papillosetaria* Vevers, 1923; *Serratospiculum* Skrjabin, 1916; *Setaria* Viborg, 1795.

The subfamily Setariinae, as created by Yorke and Maplestone, contained a mixed group of genera which are very diverse morphologically. *Dipetalonema* and *Icosiella* are so different from *Serratospiculum* and *Dicheilonema* that they cannot possibly be placed together and still permit the group to retain any unity.

Setaria is the most aberrant genus of the subfamily Dicheilonematinae, differing from the other genera in that it is a viviparous form, and its first-stage larva is long and slender and has a pointed tail, the latter devoid of spines. It has been retained in the subfamily Dicheilonematinae because it resembles the other genera in the presence of a number of rows of spines on the anterior end of the first-stage larva and because of the cuticular circumoral elevation of the adult.

Subfamily Diplotriaeninae Skrjabin, 1916

Diagnosis.—Filariidae: Oral opening dorso-ventrally elongated. Cuticle lateral to oral opening elevated in form of 2 or 4 tooth-like projections. Cuticular trident-like structures lateral to anterior end of esophagus. Oviparous. First-stage larva stout, with spines surrounding anterior and posterior ends of body.

Type genus.—*Diplotriaena* Railliet and Henry in Henry and O'Zoux, 1909.

Other genus.—*Diplotriaenoides* Walton, 1927.

Tetracheilonematinae, new subfamily

Diagnosis.—Filariidae: Oral opening surrounded by 4 conical pseudo-lips. Head separated from body by neck-like constriction. Cephalic papillae consisting of 8 papillae of external circle and 4 reduced papillae (1 papilla at tip of each of the 4 pseudo-lips) of the internal circle. Oviparous. First-stage larva with spines surrounding anterior end only; posterior end rather long and slender.

Type genus.—*Tetracheilonema* Diesing, 1861 (Syn.—*Labiatofilaria* Adams, 1933).

Subfamily Aproctinae Yorke and Maplestone, 1926

Diagnosis.—Filariidae: Oral opening more or less circular. Cephalic papillae consisting of 4 pairs of papillae of external circle; papillae of internal circle absent or, at most, with indications of internolaterals only. Esophagus sometimes divided externally into anterior short, narrow, muscular part and posterior long, broad, glandular part. Spicules equal or subequal. Oviparous. First-stage larva with spines surrounding anterior end only, tail elongated and pointed (at least in *Aprocta*).

Type genus.—*Aprocta* Linstow, 1883 (Syn.—*Lissonema* Linstow, 1903; *Striatofilaria* Lubimov, 1927).

Other genera.—*Pelecitus* Railliet and Henry, 1910; *Pseudaprocta* Shikhobalov, 1930; *Squamofilaria* Schmerling, 1925 (Syns.—*Eucamptes* Dujardin, 1845,

preoccupied; *Coronofilaria* Yorke and Maplestone, 1926).

The genera *Pelecitus, Squamofilaria,* and *Pseudaprocta* are tentatively included in the subfamily Aproctinae because of the resemblance of the adults to the genus *Aprocta.* Although the adult females of these 3 genera are reported as being oviparous, the first-stage larval characters are unknown, and it is those characters which will determine to a large degree the taxonomic position of these genera in the present classification.

DIPETALONEMATIDAE, new family

Synonym.—Dirofilariidae Sandground, 1921.

Diagnosis.—Filarioidea: Oral opening circular or dorso-ventrally elongated. Cephalic papillae consisting of 8 papillae of external circle; papillae of internal circle, if present, represented by internolaterals only. Esophagus sometimes divided into 2 morphologically distinct parts. Caudal alae usually absent. Spicules usually unequal and dissimilar, sometimes equal and similar. Viviparous. First-stage larva slender, without spines on body.

Type genus.—Dipetalonema Diesing, 1861.

At the time Sandground proposed the family name Dirofilariidae, he did not discuss it, but he must have considered the genus *Dirofilaria* as the most typical genus of the family. In the present classification, the genus *Dirofilaria* has been included in the family Dipetalonematidae, but it is less typical of the group than *Dipetalonema,* in that the 3 genera of the Dirofilariinae, as noted in the key below, are the only genera of the family Dipetalonematidae which have well developed caudal alae. *Dirofilaria* has an esophagus that is distinctly divided externally into 2 parts, whereas most of the other genera do not have the esophagus divided externally into 2 parts; *Dirofilaria* has a very short tail, whereas most of the other genera have a long tail.

Key to subfamilies of Dipetalonematidae

Caudal alae well developed; esophagus distinctly divided externally into 2 parts; tail short ..... Dirofilariinae

Caudal alae, if present, extremely narrow; esophagus usually not divided into 2 parts; tail short or long ..... Dipetalonematinae

DIPETALONEMATINAE, new subfamily

Synonyms.—Onchocercinae Leiper, 1911; Loainae Yorke and Maplestone, 1926, in part; Setariinae Yorke and Maplestone, 1926, in part.

Diagnosis.—Dipetalonematidae: Esophagus sometimes divided externally into 2 parts. Caudal alae usually absent; if present, extremely narrow. Tail short or long.

Type genus.—Dipetalonema Diesing, 1861 (Syns.—*Breinlia* Yorke and Maplestone, 1926; *Skrjabinofilaria* Travassos, 1925).

Other genera.—Aproctella Cram, 1931; *Aproctiana* Skrjabin, 1934; *Aproctoides* Chandler, 1929; *Carinema* Periera and Vaz, 1934; *Chandlerella* Yorke and Maplestone, 1926; *Elaeophora* Railliet and Henry, 1912; *Eufilaria* Seurat, 1921; *Eulimdana* Founikoff, 1934; *?Hamulofilaria* Chandler, 1924; *?Icosiella* Seurat, 1917; *Lemdana* Seurat, 1917; *Litomosa* Yorke and Maplestone, 1926; *Litomosoides* Chandler, 1931 (Syns.—*Vestibulosetaria* Vogel and Gabaldon, 1932; *Finlaynema* Vigueras, 1934); *Macdonaldius* Khanna, 1933; *?Micipsella* Seurat, 1921; *Onchocerca* Diesing, 1841; *?Onchocercella* Yorke and Maplestone, 1931; *Oswaldofilaria* Travassos, 1933; *Paraprocta* Maplestone, 1931; *Saurositus* Macfie, 1924; *Splendidofilaria* Skrjabin, 1923; *Thamugadia* Seurat, 1917.

The subfamily Onchocercinae, as defined by Leiper, was based on the presence of cuticular spiral thickenings, but recent observations have shown that these thickenings are not present in all species now included under the genus *Onchocerca* and which in every other respect conform to the generic diagnosis. Furthermore, these thickenings are not confined to species of the genus *Onchocerca,* but are present in species of other genera as well. The subfamily Onchocercinae, therefore, has been suppressed and included in a much larger group, the Dipetalonematinae.

For discussion of the subfamily Loainae, see subfamily Dirofilariinae.

Dirofilariinae, new subfamily.

Synonym.—Loainae Yorke and Maplestone, 1926, in part.

Diagnosis.—Dipetalonematidae: Esophagus distinctly divided externally into 2 parts. Caudal alae well developed, supported by pre- and post-anal pedunculated papillae. Tail short.

Type genus.—*Dirofilaria* Railliet and Henry, 1911.

Other genera.—*Loa* Stiles, 1905; *Foleyella* Seurat, 1917.

The subfamily Loainae, as defined by Yorke and Maplestone, was based exclusively on the presence of cuticular bosses and included genera that are otherwise very different morphologically. *Loa* has well developed caudal alae supported by pedunculated papillae and spicules which are unequal and dissimilar; *Micipsella* and *Splendidofilaria*, according to their present descriptions, lack caudal alae and have spicules which are subequal and similar. These 3 genera which were the only ones included in the subfamily Loainae make up a heterogeneous group. Furthermore, cuticular bosses or papillae are not confined to the 3 above-mentioned genera, but are found in such genera as *Diplotriaena* and *Squamofilaria*, and are therefore not a character belonging exclusively to genera of Loainae. For these reasons the subfamily Loainae has been suppressed and made a synonym in part of the new subfamilies Dirofilariinae and Dipetalonematinae which are much more homogeneous groups.

Family DESMIDOCERCIDAE Cram, 1927

Diagnosis.—Filarioidea: Oral opening circular. Buccal cavity subcylindrical, slightly funnel-shaped, with lateral cuticular projections at anterior end. Cephalic papillae consisting of an external circle of 8; internal circle represented by reduced internolaterals only. Esophagus divided externally into 2 parts. Caudal alae absent. Spicules unequal or subequal. Vulva pre- or post-equatorial. A tuft of spines sometimes present at tip of caudal extremity.

Type genus.—*Desmidocerca* Skrjabin, 1916 (Syn.—*Desmidocercella* Yorke and Maplestone, 1926).

STEPHANOFILARIIDAE, new family

Diagnosis.—Filarioidea: Cuticle striated transversely, posterior edges of striae smooth or with posteriorly directed spines. Lateral alae present or absent; if present, interrupted and indistinct in some parts of body. Oral opening rounded, situated on distinct elevation, the latter separated from remainder of body by deep constriction and bearing on its anterior border a circle of small spines. A crown of spines interrupted by amphids, or a group of 4 or 5 large spines in subdorsal region, posterior to elevation. Cephalic papillae consisting of 8 papillae of external circle. Esophagus short, undivided. Spicules unequal. Caudal alae absent. Vulva in anterior part of body. Viviparous.

Type genus.—*Stephanofilaria* Ihle and Ihle-Landenberg, 1933.

A note on the morphology of the anterior ends of the infective larvae of some nematodes parasitic in the alimentary tract of sheep.

John S. Andrews, U. S. Bureau of Animal Industry.

In a previous paper (1933, Tr. Am. Micr. Soc. 52: 1-25) the writer described and figured morphological details for the infective larvae of a number of nematodes parasitic in the alimentary tract of sheep. However, in that publication some of the important details of the structure of the head end of these larvae were lost through too great reduction of the original figures. These details have been re-examined in infective larvae of each of the 8 genera discussed in the previous paper and new figures have been drawn, and the infective larva of *Strongyloides papillosus* has been studied and figured. The following corrections and additions to the previous descriptions are noted:

Further study of the infective larvae of *Haemonchus contortus* and *Ostertagia circumcincta* has shown that the differences in the buccal capsule mentioned on page 19 of the previous paper are of no value in the differentiation of these larvae.

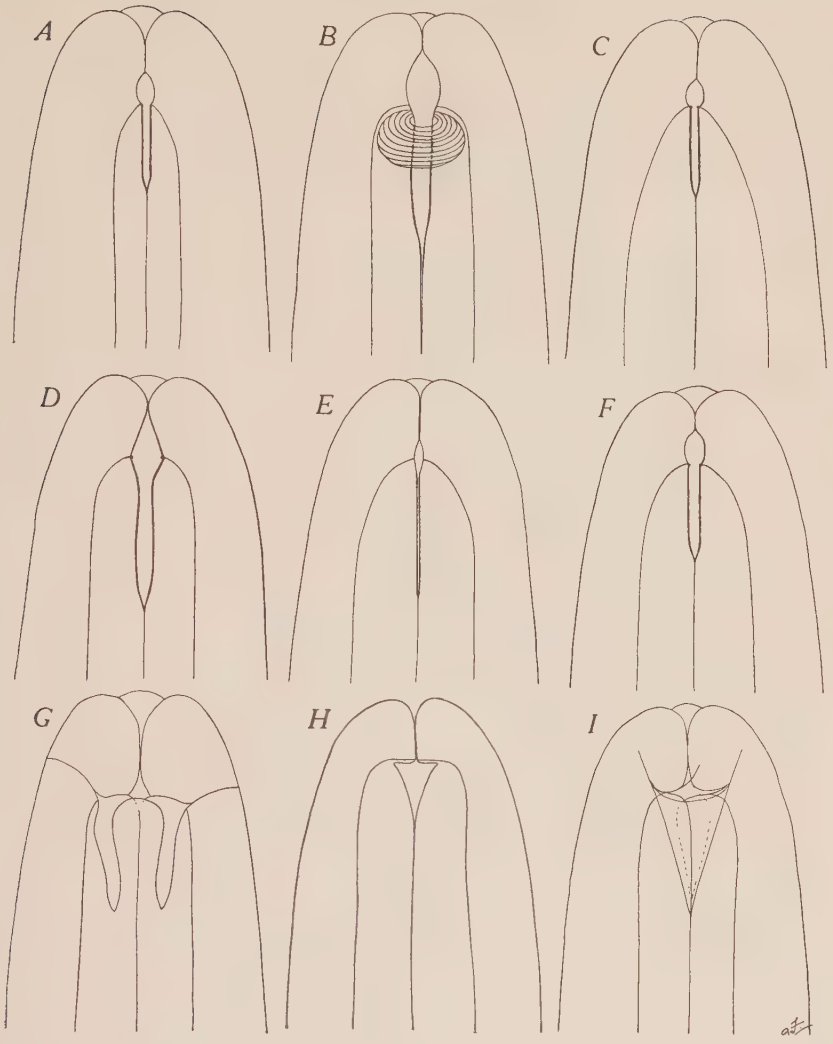

FIG. 20. Anterior ends of infective larvae.

A—*Haemonchus contortus*. B—*Cooperia curticei*. C—*Ostertagia circumcincta*. D—*Monodontus trigonocephalus*. E—*Trichostrongylus colubriformis*. F—*Nematodirus spathiger*. G—*Oesophagostomum columbianum*. H—*Strongyloides papillosus*. I—*Chabertia ovina*.

The drawing of the buccal capsule of the infective larva of *Haemonchus contortus* (Plate III, fig. 5) in that paper is incorrect; see figure 20, A of the present paper.

The "two conspicuous oval bodies" on either side of the lumen of the esophagus of the larvae of *Cooperia curticei* and *C. oncophora*, mentioned on page 12, are optical cross-sections of a group of fibers surrounding the buccal capsule, and appear only in larvae of this genus so far as has been observed; see figure 20, B of the present paper.

The "crescent-shaped" cuticularized structures at the anterior end of the esophagus of the infective larva of *Monodontus trigonocephalus*, mentioned on page 13, are the walls of an inverted cone-shaped buccal capsule, which, together with the outline of the cavity leading to the oral opening, would

give the impression of a crescent if not seen clearly; see figure 20, D of the present paper.

The details of the anterior ends of the larvae of *Oesophagostomum columbianum* and *Chabertia ovina*, mentioned on pages 15 and 17, have been more clearly outlined in figure 20, G and I, of the present paper.

The buccal capsule of *Nematodirus spathiger* is similar to those of *Haemonchus contortus* and *Ostertagia circumcincta;* see figure 20, F of the present paper.

Key for the identification of the infective larvae of the common nematodes parasitic in the alimentary tract of sheep

1. Cuticle of second-stage larva not retained; esophagus length one-half body length ..... *Strongyloides papillosus*
   Cuticle of second-stage larva retained; esophagus length less than one-half body length 2
2. Retained cuticle relatively short 3
   Retained cuticle relatively long 6
3. Band of fibers surrounding buccal capsule ..... *Cooperia spp.*
   No band of fibers surrounding buccal capsule 4
4. Buccal capsule much reduced; tubercles on posterior end of larva proper ..... *Trichostrongylus spp.*
   Buccal capsule well developed; no tubercles on posterior end of larva 5
5. Distance from anus to tip of tail of retained cuticle, 119-146μ; kink in tail sheath posterior to tail of larva proper ..... *Haemonchus contortus*
   Distance from anus to tip of tail of retained cuticle, 94-100μ; no kink in tail sheath posterior to end of larva ..... *Ostertagia circumcincta*
6. Valvular structures in anterior end of esophagus 7
   No valvular structures in anterior end of esophagus 8
7. 16-24 triangular intestinal cells ..... *Oesophagostomum columbianum*
   24-32 rectangular intestinal cells ..... *Chabertia ovina*
8. 16 intestinal cells; larva small (700μ) ..... *Monodontus trigonocephalus*
   8 intestinal cells; larva large (1,000μ) ..... *Nematodirus spp.*

A second report of the occurrence of *Trichostrongylus longispicularis* in cattle in the United States. John S. Andrews, U. S. Bureau of Animal Industry.

A short time after the first report of the occurrence of *Trichostrongylus longispicularis* in cattle in the United States had been published (1934, Proc. Helminth. Soc. Wash. 1:13), an additional specimen which agreed with the description of that nematode was found in the contents of the abomasum of a cow, this material being sent in from Florida. The only difference noted in this specimen was the apparent absence of the inconspicuous hook-like projections on the spicules. The measurements of the present specimen are as follows: Length 4.85 mm, width of head 10μ, width of body immediately anterior to bursa 88μ, length of right spicule 168μ, length of left spicule 175μ, length of gubernaculum 85μ.

***Plasmodium immaculatum* (Grassi and Feletti, 1892) Schaudinn, 1902, the correct name for the parasite causing malignant tertian malaria.** Arnaldo Giovannola, Italian Institute of Public Health, Rome, Italy.

In connection with a visit to the Zoological Division, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C., the writer took occasion to check up the nomenclature of the parasites causing human malaria, utilizing the Index-Catalog of the Division. The check indicates that the correct

name for the parasite causing malignant tertian malaria is *Plasmodium immaculatum* and the name *P. falciparum* generally used should be considered as a synonym.

Grassi and Feletti distinguished in 1892 (Atti Accad. Gioenia Sci. Nat. in Catania (4. s.) 5 (Mem. 5):23-80) 5 species of human malaria parasites: *Haemamoeba malariae* (*Plasmodium malariae* Laveran, 1881), *Haemamoeba vivax* (*Plasmodium vivax* Grassi and Feletti, 1892), *Haemamoeba praecox, Haemamoeba immaculata* and *Laverania malariae*. The last 3 names were all applied to the same parasite, the plasmodium of malignant tertian malaria.

With the name *Laverania malariae* they indicated the gametocytes of this plasmodium (the crescent bodies). With the names *H. praecox* and *H. immaculata* they indicated the young forms of this plasmodium. In *H. praecox* they saw, in peripheral blood, schizogony with pigment (a condition that can be observed in some cases of malignant tertian malaria), whereas in *H. immaculata* they never saw pigment. The authors specify also (page 51) that the schizogony of *H. praecox* and *H. immaculata* occurs generally in the internal organs. *''Le febbri estive-autunnali hanno di spesso un' impronta di gravezza tavolta insidiosamente maligna e si possono esplicare con forme perniciose continue e subcontinue . . . . . nelle febbri in discorso di raro occorre di vedere nel sangue del dito figure di sporulazione: questa si verifica a preferenza nei vasi sanguigni di alcuni organi. In conclusione siamo davanti a casi di H. praecox ed immaculata.''*

Of the 3 names used for the parasite of malignant tertian malaria, the first name, *Haemamoeba praecox* (*Plasmodium praecox*), cannot be accepted because it was previously proposed for the plasmodium of birds (Grassi and Feletti, 1890). The name *Laverania malariae* cannot be accepted because, as Schaudinn (1902) pointed out, the mere difference in shape of a gametocyte is not in itself sufficient to justify a separate generic name. On the other hand, the name *Plasmodium malariae* had been already proposed for the parasite of quartan malaria. So it follows that the name *Haemamoeba immaculata* is the first valid name used for the parasite of malignant tertian malaria.

Schaudinn (1902, Arb. K. Gsndhtsamt. 19(2):169-250) first recognized the validity of this name and proposed the new combination *Plasmodium immaculatum*. Recently another German authority in malariology, W. Kikuth, also has accepted the point of view of Schaudinn and has used the name *Plasmodium immaculatum* in his latest publication (1935, Die Malaria—Sonderdruck aus Die ansteckenden Krankheiten von Max Gundel. Leipzig).

Indeed, according to the International Rules of Zoological Nomenclature, for the validity of a new specific name it is enough *''that this name was published and accompanied by an indication''* in which case the principles of binary nomenclature have been applied (1926, Proc. Biol. Soc. Wash. 39:75-104; Art. 25, the law of priority). Furthermore, article 26 specifies that the oldest available name is retained when any stage in the life history is named before the adult.

Reading the Italian text of the paper by Grassi and Feletti, there is no doubt that the ''amamoebae'' of pernicious fevers, organisms which are characterized by marked ameboid movements, which reproduce themselves without showing any pigment, and the schizogony of which occurs generally in the internal organs, the forms indicated by the Italian authors under the name of *Haemamoeba immaculata*, are the young forms of the plasmodium of malignant tertian malaria.

The correct name for the microorganism which causes the malignant tertian malaria is, therefore, *Plasmodium immaculatum* (Grassi and Feletti, 1892) Schaudinn, 1902. Synonyms: *Haemamoeba immaculata* Grassi and Feletti, 1892, *Haemamoeba praecox* Grassi and Feletti, 1892, *Laverania malariae* Grassi and Feletti, 1892, *Haematozoon falciparum* Welch, 1897, *Plasmodium falciparum* (Welch, 1897).

The cestode *Hymenolepis microps* (Hymenolepididae) in ruffed grouse *(Bonasa umbellus).* Myrna F. Jones, U. S. Bureau of Animal Industry.

Cestodes from the intestine of the ruffed grouse, *Bonasa umbellus*, were identified as *Hymenolepis microps* (Diesing, 1850) Fuhrmann, 1906, although no rostellar hooks were observed on any of the specimens. There were available 15 vials of specimens, collected by Dr. P. P. Levine in New York State, which were sent to the Bureau of Animal Industry, on 2 separate occasions, and 7 vials of specimens, collected by Dr. C. H. D. Clark in Ontario, Canada. The material consisted of comparatively few complete specimens, a number of separate heads and numerous fragments of strobilae; in all about 25 heads were studied.

These specimens from ruffed grouse were compared with mounted specimens of Shipley's material from red grouse, *Lagopus scoticus*, of Great Britain, which Dr. O. Fuhrmann kindly furnished, and also specimens from willow grouse, *Lagopus lagopus*, of Norway, furnished by Dr. A. Brinkmann. Unfortunately no head was present on the specimens from Great Britain; 4 heads of the specimens from Norway were studied, one being sectioned, but no rostellar hooks were observed.

Fig. 21. *Hymenolepis microps.*

A—Section of rostellum showing arrangement of hooks.
B—Rostellar hooks. (After Shipley.)

Shipley (1909, Proc. Zool. Soc. Lond. (2), p. 359) referred to "very numerous spines or hooks" which are "very minute and, except in the fresh specimens, very difficult to see, and even then it requires an immersion lens to make out anything of their structure." He considered them "not less than" 16μ long. These structures (fig. 21) which Shipley described are suggestive of "spines"; they are not similar to rostellar hooks of other hymenolepid species. So far as the writer is aware, no worker has given an additional description of hooks of *H. microps;* further information, especially that derived from observation of fresh material, would be of interest. In the meantime, rostellar hooks are of little diagnostic value for the species. The very muscular cirrus pouch present in mature and gravid segments of *H. microps* serves as an important specific character for distinguishing it from unarmed species of *Hymenolepis* found in galliform birds.

The identification of cestodes from ruffed grouse as *H. microps* is of interest as indicating the presence in a native game bird of a cestode which is a common parasite of European game birds. The only previous report of this parasite from this country, that of Leidy (1887, J. Comp. M. & S. 8 (1): 1-3) of "*Taenia microps*" in the sage grouse, *Centrocercus urophasianus*, is incorrect, as was first suggested by Fuhrmann (1908, Zool. Jahrb. Suppl. 10, p. 103). The original specimens from the Leidy collection, which were kindly loaned by Dr. Percy J. Moore, have been examined and found to be a species of *Raillietina.* In so far as the writer is aware, this material represents the only cestodes from the sage grouse which have been identified as *Hymenolepis microps;* consequently, on the basis of present information, *H. microps* should not be listed as a parasite of *Centrocercus urophasianus.*

The occurrence of *H. microps* in the ruffed grouse, *Bonasa umbellus*, would then suggest that this species has been established in a native game bird in the United States only recently.

Nematodes parasitic in, and associated with, Crustacea, and descriptions of some new species and a new variety. B. G. CHITWOOD, Bureau of Animal Industry.

The occurrence of parasitic nematode larvae in Crustacea has long been known. Various members of the Copepoda, particularly *Cyclops* spp., are known to serve as intermediate hosts of *Dracunculus* spp., *Camallanus* spp., and *Philometra* spp. Sugimoto (1934, J. Japan. Soc. Vet. Sci. 13: 261-226) recently reported *Cyclops* sp. as a host for *Avioserpens taiwana* (Sugimoto, 1919) n. comb. [=*Oshimaia taiwana* (Sugimoto, 1919)= *Avioserpens denticulophasma* Wehr and Chitwood, 1934], and Prommas and Daengsvang (1933, J. Parasit. 19:287-292) have reported an infestation in *Cyclops* sp. with the larvae of *Gnathostoma spinigerum.*

Comparatively little is known of the role of Crustacea as hosts or commensals of adult nematodes. Pagenstecher (1861, Arch. Naturg. (27 J.) 1: 125-126) described adult nematodes from the body cavity of *Nicothoe* sp. under the name *Leptodera nicothoae;* unfortunately, this species appears to be unrecognizable. Baylis (1915, Ann. Mag. Nat. Hist. (8. s.) 16: 414-421) described 2 species of nematodes from the gills of crabs, *Cardisoma guanhumi* and *Gecarcinus ruricola,* from Jamaica; these nematodes were redescribed by Cobb (1920, Contrib. Sci. Nematology (9): 217-343) who added a third species from Baylis' material. The adult nematodes from crabs known at the present time are *Tripylium carcinicolum* (Baylis, 1915) Cobb, 1920, *Monhysterium wilsoni* (Baylis, 1915) Cobb, 1920, and *M. transitans* Cobb, 1920. Recently Dr. W. E. Hoffmann, School of Tropical Medicine, San Juan, Puerto Rico, sent to the writer nematodes obtained from the gills of a crab, *Gecarcinus lateralis;* this material included the 2 species of *Monhysterium* mentioned above, as well as a new variety of *Tripylium carcinicolum;* this variety is described elsewhere in this paper under the name of *T. carcinicolum* var. *calkinsi.*

Schneider (1932, Arch. Hydrobiol. 24: 629-636) reported the following nematodes from the gill chambers of crayfishes, *Potamobius* sp. and *Cambarus* sp.: *Actinolaimus macrolaimus, Chromadorita leuckarti, Dorylaimus carteri, D. centrocercus, D. flavomaculatus, D. holsaticus, Monhystera dispar, Mononchus macrostoma, Prochromadorella viridis, P. astacicola, Rhabditis inermis, R. terricola* (=*R. teres*), *Trilobus gracilis,* and *T. medius.* Of these species, *Prochromadorella astacicola* was the only one showing a consistent association with crayfishes, although when rhabditids were present in these hosts, they occurred in large numbers.

Allen (1933, J. Elisha Mitchell Sci. Soc. 49: 119-121) described as a new species *Rhabditis cambari* from the gills of *Cambarus acuminatus* and *C. blandingii,* the nematode being habitually associated with these crayfishes. A study by the writer of the type specimens, as well as of additional material, shows that the species has been inadequately described and it is, therefore, redescribed in this paper.

Dr. A. S. Pearse, Duke University, Durham, N. C., kindly gave the writer a nematode which he had collected from shrimp; this nematode proved to be an anisakid belonging to the genus *Toxocara;* for this form the name *Toxocara pearsei* is proposed.

While at the U. S. Bureau of Fisheries Laboratory, Beaufort, N. C., during the summer of 1934, the writer examined numerous crabs, and found larvae of *Rhabditis* sp. habitually present in the gills, and in one instance adult rhabditids were found in an egg mass of *Ocypode albicans.* This latter species is described in this paper as *Rhabditis ocypodis,* new species.

Rhabditis ocypodis, new species

Description.—Oral opening surrounded by 3 deeply bilobed lips, not set off from remainder of body. Cephalic papillae consisting of an internal circle of 6 conoid papillae and an external circle of papillae anterior to apices of lips. Stoma 22 to 25μ long by 5μ deep. Cuticle finely striated. Male 1.38 to

Fig. 22

A-E—*Rhabditis ocypodis*, n. sp. A—Stomatal region, dorso-ventral view. B—Stomatal region, lateral view. C—Tail of male. D—Spicules. E—Tail of female. F-H—*Toxocara pearsei*, n. sp. F—Head, *en face* view. G—Esophageal region. H—Tail of male. I-K—*Monhystera cambari* (Allen, 1933). I—Anterior end, dorso-ventral view. J—Anterior end, lateral view. K—Tail of male.

1.57 mm long, a, 29 to 33; β, 5.9 to 6.67; γ, 33 to 47. Spicules 87 to 103μ long, cephalated, rather straight, distally fused; bursa surrounding tail; genital papillae 10, arranged as in figure 22, C. Female 1.45 to 2.02 mm long; a, 26 to 35; β, 5 to 6.9; γ, 22.9 to 30. Vulva just anterior to anus; prodelphic; viviparous; 1 larva in uterus. Tail conically attenuated.

Host.—Ocypode albicans.
Location.—Eggs.
Locality.—United States (Beaufort, N. C.).
Specimens.—U. S. N. M. Helm. Coll. No. 40566 (cotypes).

This species appears to be most closely related to *Rhabditis obtusa* Fuchs, 1915, differing from that species and its varieties in that the female tail is conically spicate in *R. ocypodis* whereas it is bluntly rounded to bluntly conoid in *R. obtusa.*

Toxocara pearsei, new species

Description.—Lips bearing minute rounded denticles. Labial pulp as in *T. canis.* Cuticular striae 8 to 11μ apart. Cervical alae 1.28 mm long. Male 21 mm long by 320μ wide. Esophagus 2.4 mm long; ventriculus cylindrical, 240μ long by 120μ wide. Genital papillae consisting of 15 (or more) ventrolateral preanal papillae, 1 pair of subventral preanal papillae, 2 pairs of postanal papillae on cloacal prominence, 2 pairs of subventral and 2 pairs of ventrolateral papillae on digitiform caudal process. Phasmids between 2 groups of papillae on caudal process. Caudal alae absent. Spicules subequal, 1.2 and 1.32 mm long, respectively.

Host.—Synalpheus brooksi (Snapping shrimp).
Location.—Digestive tract.
Locality.—United States (Tortugas, Fla.).
Specimen.—U. S. N. M. Helm. Coll. No. 40559 (type)

This species is based on a single specimen collected by Dr. A. S. Pearse. *T. pearsei* differs from other species of the genus in the shape of the ventriculus; the ventriculus is more or less subglobular or ovoid in all species of this genus except *T. pearsei,* whereas in this species it is cylindroid. Ordinarily this might be considered a generic character; however, in view of the extreme similarity of this species to the other species of the genus, in other respects, particularly the structure of the lips and genital papillae, the writer hesitates to make a new genus for it. The spicules of *T. pearsei* are intermediate in length between those of *T. cati* and *T. canis.*

Monhystera cambari (Allen, 1933), new combination

Synonym.—Rhabditis cambari Allen, 1933.

Description.—Oral opening surrounded by an internal circle of 6 papillae and an external circle of 10 setae. Amphids in form of a broken circle. Stoma infundibuliform, containing 3 tooth-like esophageal projections. Esophagus cylindrical; esophago-intestinal valve very well developed. Length 643μ to 650μ; a, 8.2 to 10.2; β, 2; γ, 3.2 to 3.25. Spicules arcuate, 64μ long, slender; gubernaculum vertical; supplementary organs absent; lateral anterior pieces present. Testis single, outstretched. Female with 1 outstretched ovary; vulva dividing body into proportions of 6.5:4.

Host.—Cambarus blandingii and *C. acuminatus.*
Location.—Gills.
Locality.—United States (near Charlotte, N. C.).
Specimens.—U. S. N. M. Helm. Coll. No. 8692 and 8693 (types and paratypes.

This species is rather distinctive among species of the genus *Monhystera* because of the form of the stoma (fig. 22, I, J); because of this character it might later be considered necessary to create a new genus for it.

Tripylium carcinicolum calkinsi, new variety

Description.—Male 2.09 to 2.2 mm long; a, 23 to 26; β, 6.7 to 9; γ, 9 to 10. Female 1.95 to 2.07 mm long; a, 20 to 23; β, 8 to 9; γ, 8 to 9. Vulva dividing body in proportions of 78:22 to 88:12.

Host.—Gecarcinus lateralis.
Location.—Gills.
Locality.—Puerto Rico (Punta Congrejos).

Specimens.—U. S. N. M. Helm. Coll. No. 40567 (cotypes).

This variety is named after Dr. Gary Calkins of Columbia University who originally found the nematodes in the gills of *Gecarcinus lateralis*. The new variety differs from the typical form only in size and body proportions. Comparable measurements for the typical form are as follows: Male 1 to 1.2 mm long; a, 24 to 29; β, 5.7 to 7.2; γ, 10.5 to 13.3. Female 1.1 to 1.6 mm long; a, 18 to 32; β, 5.7 to 7.2; γ, 10.5 to 14.75; vulva dividing body in proportions 76:24 to 86.4:15.6.

Notes on free-living and plant-parasitic nematodes, II. Gerald Thorne, U. S. Bureau of Plant Industry (Salt Lake City, Utah).

(1) higher classification group of dorylaimoidea

A comparative study of nearly four hundred species of dorylaims, made while compiling a monograph of this group, has revealed certain relationships which indicate the existence of new families and subfamilies. These relationships also justify the emendation of other groups previously proposed.

Superfamily DORYLAIMOIDEA Thorne, 1934

Diagnosis.—Free-living nemas inhabiting soils and fresh-water, rarely marine. Length seldom over 10 mm. Amphids stirrup-shaped or pouch-like with slit-like or ellipsoidal apertures. Cephalic papillae arranged in 2 circlets, 6 in the inner, 10 in the outer circlet. Esophagus consisting of a slender anterior portion sometimes with small muscular swellings, followed by an expanded portion that may be reduced to a simple valveless bulb. Pharynx armed with an axial spear or mural tooth, except Alaimidae in which it is minute, tubular and unarmed. Aperture of axial spear located dorsally. Lateral series of pores and prerectum present in Dorylaimidae and Leptonchidae. Differentiated lateral wings absent; if any wings are present then of equal size distributed over entire surface. Supplements ventromedial, a preanal pair present in Dorylaimidae and Leptonchidae. Testes two in Dorylaimidae and Leptonchidae, one in Alaimidae and Diphtherophoridae. No setae or spinneret. Excretory pore generally absent or rudimentary.

Type family.—Dorylaimidae deMan, 1880.

Family DORYLAIMIDAE deMan, 1876

Diagnosis.—Dorylaimoidea: Pharynx armed with an axial spear or mural tooth. Esophagus enlarged in its posterior third or more. Polymyarian. Other characters are those of superfamily.

Type subfamily.—Dorylaiminae Filipjev, 1918.

Dorylaimidae are divided into 4 subfamilies:

Subfamily Dorylaiminae Filipjev, 1918

Diagnosis.—Dorylaimidae: Spear axial without basal knobs, flanges or tripartite extensions. Enlarged portion of esophagus not set off by constriction (except *Axonchium*).

Type genus.—*Dorylaimus* Dujardin, 1845.

Other genera included: *Discolaimus* Cobb, *Chrysonema* Thorne, *Axonchium* Cobb, *Antholaimus* Cobb and *Actinolaimus* Cobb.

Subfamily Tylencholaiminae Filipjev, 1934

Diagnosis.—Dorylaimidae: Spear axial with basal knobs, tripartite extensions or flanges.

Type genus.—*Tylencholaimus* deMan, 1876.

One other genus included: *Dorylaimellus* Cobb.

Nygolaiminae, new subfamily

Diagnosis.—Dorylaimidae with mural spear.

Type genus.—*Nygolaimus* Cobb, 1913.

One other genus included: *Sectonema* Thorne.

LONGIDORINAE, new subfamily

Diagnosis.—Dorylaimidae: Spear greatly attenuated with or without flanges. Enlarged portion of esophagus set off by constriction.

Type genus.—*Longidorus* Micoletzky, 1922.

One other genus included: *Xiphinema* Cobb.

LEPTONCHIDAE, new family

Diagnosis.—Dorylaimoidea: Length of known species not over 2.5 mm. Esophagus with only a small, basal, valveless bulb which may be continuous with the contour or set off by constriction. Spear axial (except *Campydora*), with or without basal extensions. Prerectum present. Testes 2. Preanal pair of supplements present. Meromyarian.

Type subfamily.—*Leptonchinae*, new subfamily.

The Leptonchidae probably are meromyarian representatives of the Dorylaimoidea but the exact position of the family cannot be determined upon present evidence. The species all have a characteristic faintly metallic appearance. Their reactions to fixatives and stains are unlike those of other dorylaims.

LEPTONCHINAE, new subfamily

Diagnosis.—Leptonchidae: Spear axial with or without basal extensions and knobs. Esophageal bulb lumen not forming a triquetrous chamber.

Type genus.—*Leptonchus* Cobb, 1920.

Other genera included: *Doryllium* Cobb, *Tylencholaimellus* Cobb (Syn. *Pharetrolaimus* deMan, 1921), *Tylolaimophorus* deMan (?), *Brachynemella* Cobb (?).

Tylolaimophorus typicus deMan is an indefinite form. The ellipsoid amphid apertures and cuticularized pieces about the vestibule are diphtherophoroid but in many other respects the species is leptonchoid. Likewise *Brachynemella obtusa* is doubtfully placed. If Cobb's observations "six short setae,—spear tylenchoid,—circular amphids located one spear length behind base of spear" are correct, the species represents an unknown family.

CAMPYDORINAE, new subfamily

Diagnosis.—Leptonchidae (?): Spear mural. Esophageal bulb lumen forming a triquetrous chamber.

Type genus.—*Campydora* Cobb, 1920.

The position of Campydorinae is doubtful. The single species known, *Campydora demonstrans*, lacks the definitely set off prerectum of other Leptonchidae. Males of this species are unknown.

DIPHTHEROPHORIDAE, new family

Diagnosis.—Dorylaimoidea (?): Free living nemas inhabiting soils. Meromyarian. Length of known species not over 2 mm. Lateral series of pores absent. Amphid apertures ellipsoid. Pharynx armed with an axial spear, generally complicated in structure. Vestibule surrounded by cuticularized, irregular shaped, yoke-like pieces or consisting of a cuticularized, muscular tube. Esophagus a simple slender tube with small elongate or pyriform basal bulb. Prerectum absent. Testis one. Supplements ventromedian, anal pair absent.

Diphtherophoridae is distinctive because of the complicated spear and single testis, and the absence of lateral series of pores and anal pair of supplements.

Type subfamily.—Diphtherophorinae Micoletzky, 1922.

Inclusion of Diphtherophoridae under Dorylaimoidea is a very questionable procedure. The group probably represents a distinctive superfamily or order.

Subfamily DIPHTHEROPHORINAE Micoletzky, 1922

Diagnosis.—Diphtherophoridae: Spear with basal bulbs and of complicated, arch-like construction in its dorsal sector. Submedian sectors of spear not fused distally, separated from the dorsal sector and often forming a pharynx-like cavity.

Type genus.—*Diphtherophora* deMan, 1880.
One other genus included: *Triplonchium* Cobb.

Subfamily Trichodorinae, new subfamily

Diagnosis.—Diphtherophoridae: Spear without basal bulbs, fused the entire length and not of complicated, arch-like construction distally.
Type genus.—*Trichodorus* Cobb, 1913.
Other genera included: None. *Tylolaimophorus* deMan may belong in this group.

Family ALAIMIDAE Thorne, 1934

Diagnosis.—Dorylaimoidea: Pharynx narrow, tubular, unarmed. Testis single. Preanal pair of supplements and prerectum both absent. Lateral series of pores apparently absent.
Type genus.—*Alaimus* deMan, 1880.
Other genera included: *Adorus* Cobb and *Bolbinium* Cobb, the latter doubtfully placed.

(2) the probable identity of nemonchus galeatus cobb, 1913

Specimens of *Hoplolaimus coronatus* Cobb fixed in corrosive sublimate and allowed to remain until the cuticle is disintegrated, appear to be identical in size and form to *Nemonchus galeatus* as described and figured by Cobb (1913, J. Wash. Acad. Sci. 3(16):438). *H. coronatus* is a common nema at Arlington, Virginia, the type locality of *N. galeatus*. The statement "Flemming to glycerin," may have been an error.

(3) effect of ammonium thiocyanate on nemas

A field plot heavily infested with sugar beet nematode, *Heterodera schachtii* Schmidt, was treated with ammonium thiocyanate at the rate of 400 pounds per acre in 2 applications of 200 pounds each, made November 9 and 23, 1934. The thiocyanate was first dissolved in water and then well soaked into the soil. In addition 1.65 inches of rain fell between November 17 and 30. Populations of *Heterodera schachtii* eggs and larvae from brown cysts computed November 5, 1934 and April 1, 1935 were 18,060 and 16,250 per one-millionth acre, respectively, estimated from 3 one-millionth acre samples. Populations of 18 free-living species present in the same samples were 1,198 and 1,452, respectively. Apparently none of the eggs and larvae within the cysts had been injured and even free-living species of nemas had escaped.

(4) a new slide-ringing material

Cooperating with Mr. Lyman Hunter, chemist, Salt Lake City, Utah, a large number of products and mixtures were tested for suitability as slide-ringing materials. An excellent product was finally secured consisting of two parts nitrocellulose solution and one part ADM-100, a polymerized linseed oil product used in the paint trade. Butyl acetate or acetone may be used as a thinner. Addition of powdered pigments give desired colors. The product is especially good for ringing in glycerin mounted nemas.

Water temperatures lethal to begonia, chrysanthemum and strawberry "strains" of the nematode *Aphelenchoides fragariae* (Anguillulinidae).
J. R. Christie and Louise Crossman, U. S. Bureau of Plant Industry.

In attempting to develop an effective method for treating plants infested with the nematode *Aphelenchoides fragariae* (Ritzema Bos, 1891) Christie, 1932, investigators have usually resorted to submersion in hot water. Brooks (1932, Phytopath. 21:113), working with Florida-grown strawberry plants, recommends treatment at 118.4° F. (48° C.) for 20 minutes. Christie and Stevens (1933, U. S. Dept. Agr. Circular 297, p. 8), basing their remarks on experiments by Steiner, state that treatment of diseased strawberry plants at 118° F. (47.8° C.)

TABLE 1.

EFFECT OF HOT-WATER TREATMENT ON THE STRAWBERRY "STRAIN" OF APHELENCHOIDES FRAGARIAE FROM NORTH CAROLINA PLANTS; 50 SPECIMENS TREATED IN EACH CASE

	120° F. (48.9° C.)		118° F. (47.8° C.)		115° F. (46.1° C.)		112° F. (44.4° C.)		110° F. (43.3° C.)		108° F. (42.2° C.)		106° F. (41.1° C.)	
	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost
10 min.	42	2												
12 min.	35	0												
15 min.	0	8												
20 min.	0	2												
25 min.	0	0	47	0										
30 min.	0	4	46	2	48	2								
35 min.			13	4	46	0								
40 min.			6	3	44	0								
50 min.			0	1	39	3								
1 hour			0	0	37	4	50	0						
1 hr. 15 min.			0	0	40	2	45	3						
1 hr. 30 min.			0	3	23	4	45	0						
2 hours					23	0	36	0						
2 hr. 30 min.					0	0	30	0						
3 hours					0	1	25	3						
4 hours					0	2	6	2	46	0				
5 hours					0	0	0	2	30	5				
6 hours							0	0	25	0				
7 hours							0	2	6	0				
8 hours							0	0	0	4				
10 hours									0	0	35	0		
12 hours									0	0	28	1		
15 hours									0	1	0	0		
18 hours											0	0	4	0
21 hours											0	0	2	0
24 hours											0	0	2	0
30 hours													0	1
36 hours													0	?*
42 hours													0	0
48 hours													0	?*

*The maceration and clumping together of dead specimens made an exact final count impossible.

for 30 minutes is effective. Staniland and Beaumont (1932, Seale-Hayne Agr. Coll., 10th Ann. Rept., Dept. Plant Pathology, p. 14) found that strawberry plants treated at 110° F. (43.3° C.) for 15 and 20 minutes did not subsequently develop "red plant" or "cauliflower" disease. However, they found that some of the nematodes survived this treatment.

For chrysanthemums infested with the chrysanthemum "strain" of this nematode, Hodson (1933, Hort. Ed. Assoc. Year Book, 2:89) recommends treating the stools at a temperature of 110° F. (43.3° C.); 20 minutes if the stools are small, 30 minutes if of moderate or large size.

In preliminary experiments treating North Carolina-grown strawberry plants infested with *A. fragariae* at 118° F. (47.8° C.), the writers found that in some of the plants a few nematodes survived treatments for 30 and 45 minutes. All were apparently killed in 55 minutes.

TABLE 2.

EFFECT OF HOT-WATER TREATMENT ON THE STRAWBERRY "STRAIN" OF APHELENCHOIDES FRAGARIAE FROM MASSACHUSETTS PLANTS; 50 SPECIMENS TREATED IN EACH CASE

	120° F. (48.9° C.)		118° F. (47.8° C.)		115° F. (46.1° C.)		112° F. (44.4° C.)		110° F. (43.3° C.)		108° F. (42.2° C.)		106° F. (41.1° C.)		104° F. (40° C.)		102° F. (38.9° C.)		100° F. (37.8° C.)	
	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost
5 min.	0	0	2	0	17	0														
10 min.	0	0	0	2	0	4														
12 min.	0	0	0	3	0	0	12	3												
15 min.							4	0	40	0										
20 min.							0	0	21	0										
25 min.							0	0	19	1	45	0								
30 min.									2	0	29	0								
35 min.									5	0	31	0								
40 min.									0	0	23	0								
50 min.									0	3	8	5								
1 hour											0	0	30	0						
1 hr. 15 min.											0	0	22	0						
1 hr. 30 min.													17	1	43	1				
2 hours													4	0	14	0				
2 hr. 30 min.													0	0	16	0				
3 hours													0	0	10	0				
4 hours															2	0				
5 hours															1	0	13	0		
6 hours															0	1	4	3		
7 hours															0	0	2	0		
8 hours																	3	2		
10 hours																	0	0	3	3
12 hours																	0	4	4	0
15 hours																			0	0
18 hours																			0	2

Believing that more specific information was needed in regard to the ability of these nematodes to withstand submersion in hot water, the writers undertook a series of experiments with this point in mind. The strawberry "strain" was secured from two localities: (a) From infested plants of the Howard 17 (Premier) variety collected by the writers near Falmouth, Mass., and (b) from infested plants of the Klondike variety collected at Chadbourn, N. C., by G. A. Meckstroth. Infested begonias, secured from a greenhouse in the state of Washington and sent by W. D. Courtney, furnished material of the begonia "strain." The chrysanthemum material came from near New York City and was supplied by B. O. Dodge. The forms which are herein designated chrysanthemum and begonia "strains" are presumedly the same as those which are frequently referred to as *A. ritzema-bozi* and *A. olesistus*, respectively.

The nematodes were removed from the plants and treated in lots of 50 specimens each. Nearly full-grown individuals were selected and both 4th-stage larvae (preadults) and adult males and females were included. While 4th-stage

TABLE 3.

EFFECT OF HOT-WATER TREATMENT ON THE CHRYSANTHEMUM "STRAIN" OF APHELENCHOIDES FRAGARIAE; 50 SPECIMENS TREATED IN EACH CASE

	115° F. (46.1° C.)		112° F. (44.4° C.)		110° F. (43.3° C.)		108° F. (42.2° C.)		106° F. (41.1° C.)		104° F. (40° C.)		102° F. (38.9° C.)		100° F. (37.8° C.)	
	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost
10 min.	3	0														
12 min.	0	0														
15 min.	0	0														
20 min.			50	0												
25 min.			30	0												
30 min.			26	0												
35 min.			37	1												
40 min.			28	0												
50 min.			44	0	37	0										
1 hour			2	2	43	0										
1 hr. 15 min.			0	3	22	0										
1 hr. 30 min.			0	0	12	1										
2 hours					16	0	43	0								
2 hr. 30 min.					1	0	39	0								
3 hours					0	0	12	0								
4 hours					0	0	2	0	44	0						
5 hours							0	0	24	0						
6 hours							0	0	11	0						
7 hours									1	0	17	0				
8 hours									0	0	28	0				
10 hours									0	0	22	0				
12 hours											4	0	37	2		
15 hours											0	0	13	0		
18 hours											0	8	0	0	23	0
21 hours													2	0	46	0
24 hours													0	1	14	0
30 hours													0	0	0	0
36 hours															0	0

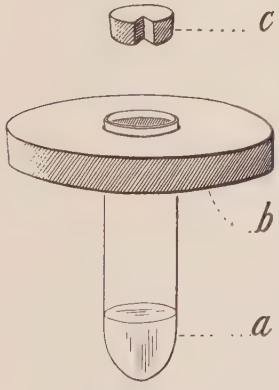

FIG. 23

Device employed for the hot water treatments of *Aphelenchoides fragariae*. A—test tube; B—cork disk; C—cork stopper.

larvae are the most resistant to treatment, the difference between them and adults does not appear to be very pronounced. The specimens were picked into a test tube about 35 mm long by 10 mm in diameter, with straight sides, and containing about 0.5 cc of water. The upper (open) end of the test tube was inserted into a thin cork disk (fig. 23) which, when placed in a thermostatically controlled water bath, floated on the surface of the water. The test tube was completely submerged except for that part of the upper end which was inserted in the cork disk. For the shorter treatments the test tube remained open at the top; for longer treatments it was corked to reduce evaporation, but the cork was notched to permit limited aeration. The temperature of the water in the test tube was raised to that of the surrounding water within a period of one minute or less.

After treatment the water in the test tube, together with the nematodes, was poured into a Syracuse watchglass and enough water added to form a thin film over the bottom. The watchglasses were

TABLE 4.

EFFECT OF HOT-WATER TREATMENT ON THE BEGONIA "STRAIN" OF APHELENCHOIDES FRAGARIAE; 50 SPECIMENS TREATED IN EACH CASE

	115° F. (46.1° C.)		112° F. (44.4° C.)		110° F. (43.3° C.)		108° F. (42.2° C.)		106° F. (41.1° C.)		104° F. (40° C.)		102° F. (38.9° C.)		100° F. (37.8° C.)	
	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost	No. revived	No. lost
5 min.	0	0	46	0	50	0										
10 min.	0	0	10	0	44	0										
12 min.	0	0	4	0	33	0										
15 min.	0	0	0	1	9	0										
20 min.			0	0	1	0										
25 min.					0	0										
30 min.					0	0	29	0								
35 min.					0	0	15	0								
40 min.					0	0	9	0								
50 min.							6	0								
1 hour							2	0	6	0						
1 hr. 15 min.							0	2	6	0						
1 hr. 30 min.							0	0	0	1	47	0				
2 hours									0	0	32	0				
2 hr. 30 min.									0	0	2	0	42	0		
3 hours									0	0	0	0	18	0		
4 hours											0	0	2	2		
5 hours													0	0	49	0
6 hours													0	0	44	0
7 hours															46	0
8 hours															7	1
10 hours															7	0
12 hours															1	1
15 hours															0	0
18 hours															0	0

not covered and were kept in a moist chamber at room temperature. Examinations were made daily and all revived specimens counted and removed. Specimens sometimes continued to revive for about 4 days. After 6 days the remaining dead specimens were counted and the experiment terminated. In some cases a few specimens were lost during the course of the experiment. Results are given in the accompanying tables. In the left column, under each temperature, are recorded the specimens which revived, in the right column the specimens which were unaccounted for.

The time required to treat an infested plant effectively at a given temperature may possibly be longer than that required to kill the parasites after removal from the plant. It is not likely to be less. In experiments treating infested North Carolina strawberry plants at 118° F. (47.8° C.), as already noted, specimens of *A. fragariae* survived in some plants for 30 and 45 minutes, but were apparently all killed in 55 minutes. These results check with those given in table 1. Any treatment, to be of much practical value, must kill *all* the individuals of *A. fragariae* in the plant. In the case of strawberry plants, when a few parasites survive and the plants recover, the infestation will usually persist. Such plants may not develop symptoms for a considerable time after treatment, nevertheless the infestation is always potentially capable of producing symptoms.

One of the outstanding points in connection with the above results is the marked differences in the ability of the various "strains" of the nematode to survive hot-water treatment. Of special interest is the striking difference

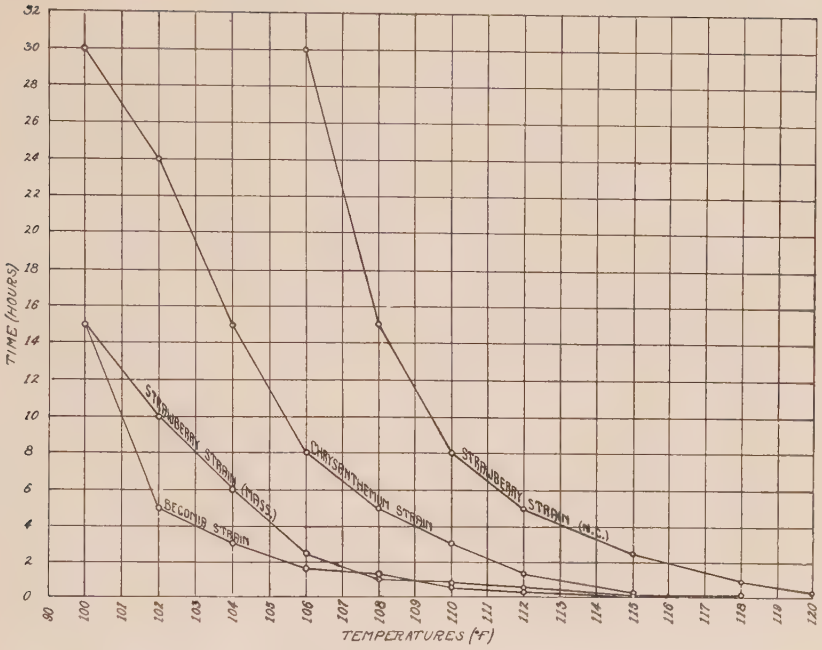

FIG. 24.

Time required to kill *Aphelenchoides fragariae* at different water temperatures.

between specimens from Cape Cod strawberry plants and specimens from North Carolina strawberry plants. The strawberry, chrysanthemum and begonia "strains" of this nematode exhibit slight morphological differences. Whether these are sufficient, either with regard to degree or constancy, to make possible the recognition of separate species is a controversial point and need not be discussed here. Specimens from Masachusetts-grown strawberry plants are morphologically identical, so far as can be determined, with those from strawberry plants grown in the southern states.

Nevertheless disease symptoms as they occur in Massachusetts, differ in appearance and seasonal occurrence from disease symptoms as they occur in the South. The reason for this has never been satisfactorily explained. The marked difference in the ability of *A. fragariae* specimens from the two localities to withstand hot-water treatment strongly suggests the existence of two physiological "races" or "strains" peculiar to the two regions. If this be true, the difference in the seasonal behavior of diseased strawberry plants can be more readily understood.

It becomes evident that apparent discrepancies in the results of hot-water treatment experiments by different investigators for ridding plants of this nematode do not necessarily imply inaccuracies. Treatment at 115° F. (46.1° C.) for 10 to 15 minutes would apparently be effective in cleaning infested strawberry plants from Cape Cod but would evidently not be effective with infested strawberry plants from North Carolina.

Opuscula miscellanea nematologica, II. G. Steiner, U. S. Bureau of Plant Industry.

(1) New nematodes observed in diseased Irish potatoes from Cuba

A new species of *Aphelenchoides,* apparently of parasitic character, was found in Irish potatoes, originating from Cuba and collected in ship stores by an inspector of the Bureau of Entomology and Plant Quarantine in New Orleans. The potatoes exhibited the symptoms shown in figure 25. The surface had very pronounced lesions, was very rugose and discolored blackish-brown. In these lesions numerous specimens of the *Aphelenchoides* species were found. It is thought that this new species, *Aphelenchoides solani,* n. sp., is the principal disease agent, though experimental proof is still lacking. A *Cephalobus* species, associated with the *Aphelenchoides* in the diseased potatoes, also seems to be new and is here described as *Cephalobus cubaënsis,* n. sp.

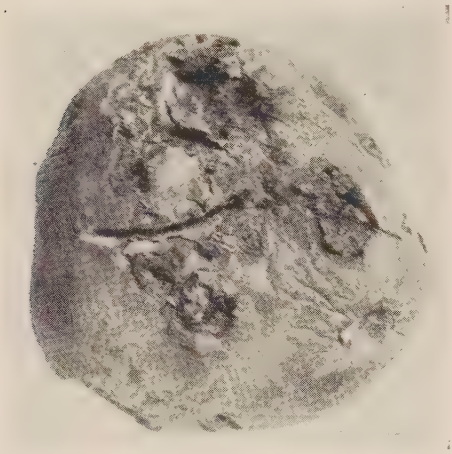

Fig. 25
Irish potato with lesions apparently produced by *Aphelenchoides solani,* n. sp. Natural size.

Aphelenchoides solani, n. sp. (Fig. 26, A-C).

Description.—Females only seen. Body very slender; head broad, obtuse, not set off. Tail short cylindrical, with irregularly obtuse terminus. Annulation very fine; annules about 1μ wide. Head 6-radiate, segments marked by cuticular framework. Four quite plain, submedial papillae. Amphids slightly anterior to the papillar circle. Head not annulated. Cheilorhabdions present. Buccal stylet rather indistinctly set off from oesophagus; conical anterior portion well cuticularized, distinct; cylindrical posterior portion faint; end of buccal stylet without basal knobs, marked only by attachment of protrudor muscle. Middle bulb of esophagus ellipsoidal with well developed muscles. Esophageal glands and their plainly visible openings in position typical of genus. Rectum about as long as tail, the latter measuring twice anal body diameter. Vagina of female quite well cuticularized. Postvulvar branch of uterus very small.

Measurements.—♀: total length = .861 to .895 mm; a = 48 to 49.3; β = 8.4 to 9.6; γ = 31 to 31.7; v = 76 to 77 per cent.

Diagnosis.—*Aphelenchoides* with very slender body; head not set off; tail cylindrical with irregularly obtuse terminus; buccal stylet about 20μ long, anterior conical portion plainly visible and well cuticularized, posterior cylindrical portion (shaft) faint, hardly differentiated from esophageal canal, without basal knobs; end of stylet marked only by attachment of protrudor muscle; rectum about as long as tail; female with very short postvulvar uterine branch. Males unknown.

Type locality.—Cuba.

Type host.—Irish potato.

Cephalobus cubaënsis n. sp. (Fig. 26, D, E, F)

Description.—Species closely resembling *Cephalobus maximus* (Thorne) Steiner, but of much smaller size, with unequal probolae, the dorsal one being decidedly higher than the subventral ones. Lateral membranes 2, close together.

Fig. 26
A-C—*Aphelenchoides solani,* n. sp. A—Lateral view of head end; X 2100. B—Esophageal region; X 800. C—Region of vulva and tail end; X 520. D-F—*Cephalobus cubaënsis,* n. sp. D—Lateral view of head end; X 2100. E—Esophageal region; X 520. F—Vulvar region and tail end; X 520.

Fig. 26

Annulation of cuticle quite distinct. Six cephalic papillae. Amphids dorsal behind lateral papillae. Buccal armature as follows: Cheilorhabdions strong, very distinct; pro-, meso-, meta- and telo-rhabdions thin. Metarhabdions with faint indication of a dorsal denticle. Middle esophageal bulb well marked off, of same length as corpus. Terminal esophageal bulb large, almost spherical. Tail slightly conical, with obtuse but mucronate terminus. Phasmid in the middle of tail. Female apparatus typical of the genus. Vulvar lips slightly protruding. Ovary without S-shaped flexure.

Measurements.—♀: total length = .480 mm; $a = 26.6$; $\beta = 4.1$; $\gamma = 15$; v = 65 per cent.

Diagnosis.—*Cephalobus* resembling *C. maximus* but different in that it is of smaller size with unequal probolae, the dorsal being much higher than those subventral; tail cylindrical with obtuse mucronate terminus; lateral membranes 2, close together; buccal cavity with thin pro-, meso-, meta-, and telo-rhabdions; denticle on dorsal metarhabdion only faintly marked; ovary without S-shaped flexure.

Type locality.—Cuba.

Type host.—Irish potato.

(2) APHELENCHOIDES HUNTI, N. SP., A NEW NEMATODE PARASITIC IN TIGER LILY BULBS (LILIUM TIGRINUM) AND FRUITS OF THE TOMATILLO (PHYSALIS IXOCARPA)

In 3 diseased bulbs of *Lilium tigrinum*, originating from Japan and collected by an inspector of the Bureau of Entomology and Plant Quarantine, numerous specimens of *Aphelenchoides hunti*, n. sp. were found. The situation under which this new nema occurred strongly suggests a pathological significance. The species is named after N. Rex Hunt of the Bureau of Entomology and Plant Quarantine, who has transmitted to us so much interesting material. Subsequently this same species was found in diseased fruits of the tomatillo imported from Mexico and intercepted at Mobile, Ala.

Aphelenchoides hunti, n. sp. (Fig. 27, A-D)

Description.—Somewhat resembles *A. xylophilus* Steiner & Buhrer, 1934. Males and females about equally numerous; both exceedingly active. Body cylindroid, tapering anteriorly as well as posteriorly rather rapidly. Tail end of female conoid, sometimes sharply pointed, sometimes slightly obtuse. Tail of male similar but shorter and more conical. Head end set off; annulation of cuticle sometimes plain, sometimes very fine; annules about 1μ wide. Middle region of body with 3 lateral longitudinal striae. Buccal spear long, well cuticularized, with basal knobs sometimes only slightly developed. Middle esophageal bulb ovoid, well developed, strongly muscular, with valves. Female with quite large posterior uterine branch. Ovary not reflexed. Oviduct subdivided, with well differentiated sections, the most outstanding being a muscular portion attached to the uterus. Apparently viviparous. Spicula of male reminiscent of those of *A. xylophilus*, with pointed, long, ventral apophysis. No gubernaculum seen. Arrangement of copulatory papillae: One ventrosubmedial about half body width from, and in front of, anus; one ventrosubmedial at the latitude of the anus; and a triplet ventrosubmedial slightly behind middle of tail. Bursal muscles well developed.

Measurements.—Specimens from tiger lily: ♀: total length = .59 to .83 mm; $a = 22$ to 29; $\beta = 8.5$ to 11; $\gamma = 9.8$ to 13.2; v = 72 to 83 per cent. ♂: total length = .62 to .74 mm; $a = 24$ to 28; $\beta = 9.6$ to 11.1; $\gamma = 17$ to 21. Specimens from tomatillo: ♀: total length = .79 to .88 mm; $a = 24$ to 26; $\beta = 10.5$ to 12.2; $\gamma = 10.5$ to 12.9; v = 74 to 75 per cent; ♂: total length = .800 mm; $a = 26$; $\beta = 11.5$; $\gamma = 20$.

Diagnosis.—*Aphelenchoides*, resembling *A. xylophilus*, but female tail longer, more conical and pointed. Male tail with different arrangement of copulatory papillae (fig. 27, D). Buccal stylet longer.

Type locality.—Japan.

Type host.—*Lilium tigrinum.*

(3) OBSERVATIONS ON NEMAS FROM STERNBERGIA LUTEA

The neck region of a diseased bulb of *Sternbergia lutea*, submitted from Redlands, Calif., harbored various nemas, three of which are new. The forms

found were: A species of *Rhabditis* (single female), *Neocephalobus compsus*, n. sp. (single female), *Panagrolaimus heterocheilus*, n. sp. (3 specimens), and *Cephalobus symmetricus* (Thorne) emend. (numerous specimens). It is thought that these various forms are secondary disease agents only. Since this *Sternbergia* bulb had been imported from Palestine, there is a possibility that the nemic forms listed originated in that country.

Neocephalobus compsus, n. sp. (Fig. 28, A-D)

Description.—Body very slender, tail long, conical, pointed. Annulation fine, but distinct; no information about lateral membranes available; head not annulated, slightly set off, with 6 well separated, high lips, each with pointed papilla. Amphid not seen. Buccal cavity cephaloboid, but only cheilo- and prorhabdions developed and cuticularized; position of meso-, meta- and telorhabdions, however, marked by breaks in the tissue surrounding buccal cavity.

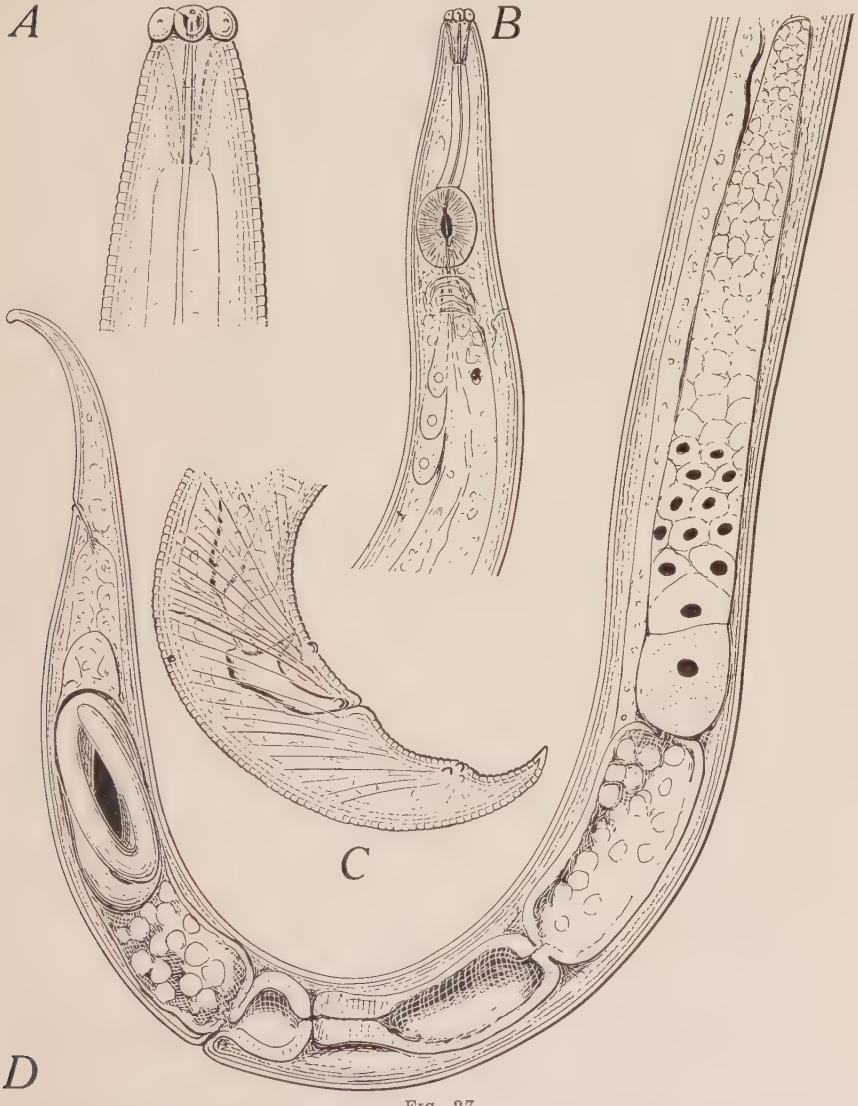

FIG. 27

Aphelenchoides hunti, n. sp. A—Head end; X 1320. B—Anterior portion of body; X 935. C—Tail end of male; X 470. D—Posterior end of female body with sexual apparatus; X 470.

Esophagus cephaloboid, corpus cylindrical, slender, middle bulb set off by mark, almost as long as corpus but not wider; isthmus short; terminal bulb pear-shaped, with reduced valvular apparatus, only longitudinal valves seen. Intestine thin-walled. Rectum slightly longer than anal body diameter. Vulva at 76.5 per cent; short postvulvar uterine branch present. Female apparatus prodelphic; ovary with double flexure in region behind postvulvar uterine branch.

Measurements.—♀ : total length = .669 mm; $a = 38.8$; $\beta = 5.4$; $\gamma = 16.4$.

Diagnosis.—*Neocephalobus* with long, conical, pointed tail; with 6 equal, well separated, high lips with pointed papilla; middle esophageal bulb not swollen, but well differentiated, as long as corpus; terminal bulb well developed but with reduced valvular apparatus of which only longitudinal valves are present. Vulva at 76.5 per cent; short postvulvar uterine branch; double flexure in postvulvar portion of ovary.

Type locality.—United States (California) [? Palestine].

Type host.—Bulb of *Sternbergia lutea.*

Panagrolaimus heterocheilus, n. sp. (Fig. 28, E-H)

Description.—Male quite slender, female less so. Tail of female short, conical, sharply pointed, that of male similar, but terminal point set off. Head not annulated; annules about 1μ wide. Lateral membranes perhaps 2, not definitely made out. Six lips, the 2 lateral much smaller, the 4 submedial high, pointed (fig. 28, E). Each lip apparently with single papilla; amphids posterior to lateral papilla, shifted slightly dorsad. Buccal cavity typically cephaloboid, with full set of armature plates, without teeth. Oesophagus with cylindrical corpus, with distinctly set off middle bulb, 2½ times as long as wide, with narrow isthmus and pear-shaped terminal bulb. Valvular apparatus in latter somewhat reduced; middle set of valves (anvils!) apparently absent. Intestine with remarkably thin walls. Excretory pore ventral behind nerve ring. Female apparatus prodelphic, entirely to the right of intestine, with vulva at 60.5 per cent, with short posterior uterine branch, with reflexed, straight ovary ending about one tail-length in front of anus. Postvulvar portion of ovary slightly swollen. Male with short, reflexed testis, with its outlets situated dorsal and to the right of intestine. Spicula distally curved, about 2/3 as long as tail, with gubernaculum 1/3 as long and partly enveloping spicula. Arrangement of copulatory papillae apparently as follows: 3 ventrosubmedial almost equidistant in front of anus, the most anterior one twice length of spicula in front of anus; 1 ventrosubmedial and 1 lateral in latitude of anus; 3 ventrosubmedial, also equidistant, on conical portion of tail; a lateral one (perhaps the phasmid!) in latitude of the most anterior one of the 3; and a subdorsal one at about the beginning of last third of tail (fig. 28, G).

Measurements.—♀ : total length = .795 mm; $a = 24.7$; $\beta = 5$; $\gamma = 23.1$; v = 60.5 per cent; ♂ : total length = .623 mm; $a = 32.3$; $\beta = 3.5$; $\gamma = 18.1$.

Diagnosis.—*Panagrolaimus* with unequal lips, the lateral being much smaller and not so pointed as the submedial; buccal cavity without teeth but with full set of armature plates; middle esophageal bulb set off, slightly swollen, three times as long as wide; tail short, conical, sharply pointed; in male terminal point set off, spicate. Copulatory papillae as follows: 3 ventrosubmedial in front of anus, almost equidistant, most anterior one about twice length of spicula in front of anus; a ventrosubmedial and a lateral one in latitude of anus; 3 ventrosubmedial, a lateral and a dorsosubmedial one on conical portion of tail, the 3 ventrosubmedial ones equidistant, the lateral (phasmid?) in latitude of first submedial papilla, the subdorsal near beginning of last third of tail.

Type locality.—United States (California) [? Palestine].

Type host.—*Sternbergia lutea.*

Fig. 28

A-D—*Neocephalobus compsus*, n. sp. A—Head end; X 1400. B—Anterior end to beginning of intestine; X 430. C—Tail end of female; X 530. D—Region with female sexual apparatus; X 530. E-H—*Panagrolaimus heterocheilus*, n. sp. E—Head end; X 1400. F—Anterior end to beginning of intestine; X 530. G—Tail end of male; X 530. H—Posterior end of female with sexual apparatus; X 346. I-L—*Cephalobus symmetricus* (Thorne, 1925) emend. I—Head end with bifurcated labial probolae; X 1400. J—Schematic outline of female apparatus with double flexure in ovary. K—Anterior end of specimen, labial probolae of which are not bifurcated; X 530. L—Region of sexual apparatus of female without double flexure in ovary; X 346.

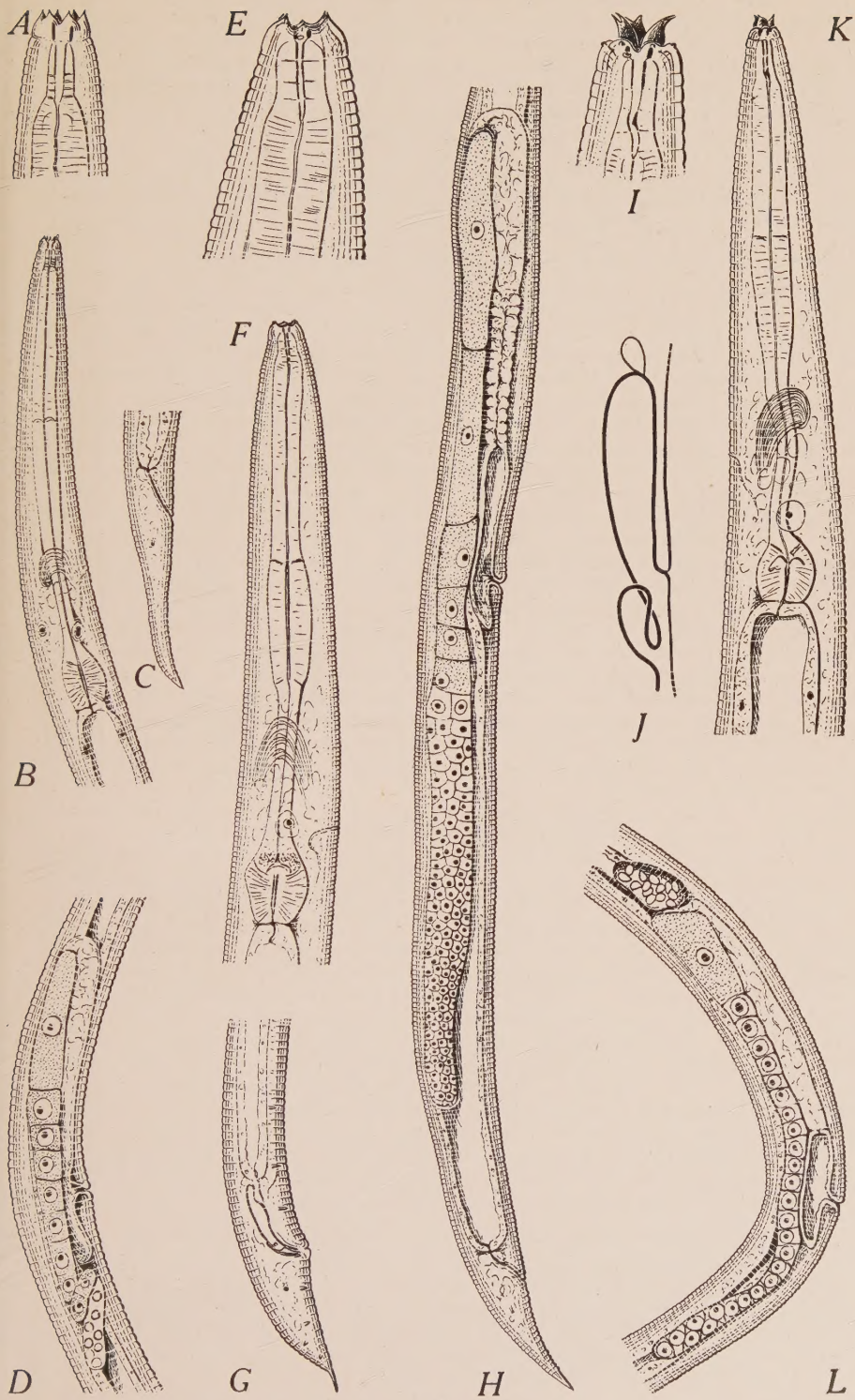

Fig. 28

Remarks concerning the genus Panagrolaimus Fuchs 1930 *and Procephalobus Steiner* 1934.

Chitwood (1935, Proc. Helminth. Soc. Wash. 2: 53) made *Panagrolaimus detritophagus* Fuchs, 1930 type of the genus *Panagrolaimus* Fuchs, 1930. This makes *Procephalobus* Steiner, 1934 a synonym of *Panagrolaimus* Fuchs, 1930. The diagnosis given by Steiner for *Procephalobus* (1934, Proc. Helminth. Soc. Wash. 1: 55) becomes the diagnosis for *Panagrolaimus.*

Remarks concerning Cephalobus symmetricus (*Thorne,* 1925)

This species was originally described by Thorne from Utah and Colorado. In the present case numerous specimens, larvae and adults of both sexes, were seen, all agreeing fairly well with the original description by Thorne. However, a few interesting points about this form may be recorded here. A check of numerous specimens showed that in this species there exists variability in the labial probolae similar to that described for *C. contortus* in a former paper (1934, Proc. Helminth. Soc. 1:56-58). Figure 28, K shows the anterior end of a specimen in which the labial probolae end in a single point, the normal being, however, the bifurcated type drawn in figure 28, I. The former kind was seen in only three specimens, which, however, agreed well with the type in other characters. There seem to be 6 low, rounded, cephalic papillae in this species. The amphid is shown in figure 28, I. The female apparatus is remarkable because of a special receptaculum seminis which is sac-shaped and placed at a point where the oviduct turns to the reflexed ovary. The presence of such a receptaculum seminis in a species of the Cephalobinae is novel and of much interest. In the prodelphic Cephalobinae the occurrence of double flexures in the ovary is often observed, particularly in members of the genus *Cephalobus.* The question arose to what degree such flexures may be considered as of taxonomic value. The present observations seem to show that such flexures may be present or absent in members of the same species. Figure 28, L shows the female apparatus of a specimen of *C. symmetricus* from *Sternbergia* with no flexure, whereas figure 28, J represents schematically the flexures most frequently seen in specimens of this very same species from the same host. At least in the present case these flexures are therefore of a very variable type and should not be used for the taxonomic characterization of this species. It would be well to pay more attention to these structures in future studies of the members of the Cephalobinae.

(4) THE GENUS PARASITAPHELENCHUS FUCHS, 1929

The genus *Parasitaphelenchus* was proposed without a diagnosis by Fuchs, 1929 (Ztschr. Parasitenk. 2(2):248-285) for the species *P. uncinatus* which, in a previous paragraph of the same paper, he called *Tylenchus uncinatus.* A description of this new genus was given in 1930 and many other new species added. However, the generic characters were not clearly formulated, and on the basis of the description it was not possible to differentiate *Parasitaphelenchus* from *Aphelenchoides.* Not knowing the 1929 publication of Fuchs and the mention therein of *Parasitaphelenchus uncinatus* in a manner that allows its status to be that of a type species, Chitwood (1935, Proc. Helminth. Soc. Wash. 2:53) designated *Parasitaphelenchus conjunctus* Fuchs, 1930, as type species. However, the previous (1929) use of *Parasitaphelenchus,* mentioning the single species, *P. uncinatus,* constitutes type by monotypy, hence, according to an oral communication by Dr. Chitwood, his subsequent designation is invalid. Therefore as *P. uncinatus* remains type, and since a new, closely resembling species has been discovered which will be described elsewhere, a diagnosis of the genus is given, restricting it to forms resembling *P. uncinatus.*

Genus *Parasitaphelenchus* Fuchs, 1929

Diagnosis.—Resembling *Aphelenchoides* but larvae parasitic in body cavity of bark beetles; with oral opening more or less obliterated and head covered with cuticular cap, ending very characteristically in a ventrally directed point. Adult generation free-living, of the general type of *Aphelenchoides.* Males unknown. Females apparently protandric hermaphrodites.

Type species.—*P. uncinatus* Fuchs, 1929.

The control of the root-knot nematode, *Heterodera marioni* (Cornu) (Anguillulinidae), on tuberoses by hot water and vapor heat. GRACE W. SHERMAN, U. S. Bureau of Plant Industry.

These investigations were made in cooperation with Dr. C. A. Weigel and Mr. R. H. Nelson of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, and Dr. R. W. Leiby of the North Carolina Department of Agriculture for the purpose of determining the effectiveness of a hot-water or a vapor-heat treatment as a means of ridding tuberoses of the bulb mite, as well as of the root-knot nematode. The results in regard to the bulb mite will be published as a scientific note in the Journal of Economic Entomology.

Treatments were made with both hot water and vapor heat at 110, 112, 114 and 116° F. for 1 hour, and at 118, 120, 122 and 124° F. for ½ hour. The 118° F. treatment was also made for 1 hour with vapor heat. In each lot 12 root-knot-infested tubers were used, 2 of which were reexamined for nematodes after treatment, and the rest planted in a greenhouse. Larger lots were treated later and planted at Arlington Farm, Va., and at Magnolia, N. C., for tolerance tests.

The tuberoses planted in the greenhouse grew and thrived, although greenhouse conditions may have kept the plants from being strictly normal. Careful observations and measurements were made weekly for the 7 weeks of the blooming period.

The plants were allowed to dry down before digging, and some of the roots were quite dry before examination of the tubers for the root-knot nematode. Living specimens of *Heterodera marioni* were found in tubers treated with hot water of 110, 112 and 114° F. for 1 hour. No root-knot was found in tubers treated at 116° F. for 1 hour, or at 118° F. or above for ½ hour. In the vapor-heat series root-knot was found in all lots up to and including that treated at 122° F. for ½ hour. Although in many of the tubers infestation was not heavy, only the lot treated at 124° F. seemed entirely free from this nematode. From these results it appears necessary to go to much higher temperatures with vapor heat than with hot water for a complete kill. The plants, however, appeared to withstand all the temperatures and treatments used in these tests without injury.

MINUTES

One hundred sixty-eighth to one hundred seventy-second meetings

The 168th meeting was held on January 19, 1935. Papers were presented by Drs. Ewing, Steiner and Jones. Mr. E. L. Miller of Louisiana State University was elected a member of the Society. A motion was made, seconded and carried that a member's space in the PROCEEDINGS was at the disposal of the individual member and that he or she might dispose of this space as desired.

The 169th meeting was held on February 16, 1935. Papers and notes were presented by Grace Sherman, Mr. McIntosh, Drs. Steiner and Wright. The committee on the utilization of the Ransom Memorial Fund was discharged and a new committee appointed.

The 170th meeting was held on March 16, 1935. Papers were read by Drs. Horsfall and Ewing. (See present issue.) Dr. Hall gave an illustrated lecture, "The War on Parasites."

The 171st meeting was held on April 20, 1935. The usual order of business and the program were dispensed with in order to allow time for Dr. Cort to present an illustrated lecture on his recent trip to Egypt.

The 172nd meeting was held on May 18, 1935. Papers and notes were presented by Dr. and Mrs. Chitwood, Drs. Dikmans, Steiner and Skinker, Messrs. McIntosh and Kerr. Dr. Steiner presented a preliminary report for the recently appointed committee on the utilization of the Ransom Memorial Fund.

G. DIKMANS, *Recording Secretary.*

CONTENTS

PAGE

ANDREWS, JOHN S. A note on the morphology of the anterior ends of the infective larvae of some nematodes parasitic in the alimentary tract of sheep 88

————————. A second report on the occurrence of *Trichostrongylus longispicularis* in cattle in the United States 90

CHITWOOD, B. G. Nematodes parasitic in, and associated with, Crustacea, and descriptions of some new species and a new variety 93

CHRISTIE, J. R. and CROSSMAN, LOUISE. Water temperatures lethal to begonia, chrysanthemum and strawberry "strains" of the nematode *Aphelenchoides fragariae* (Anguillulinidae) 98

DIKMANS, G. Parasites of cattle in Costa Rica 83

————————. A note on the identity of *Cooperia punctata* Ransom, 1907, and *C. fieldingi* Baylis, 1928 (Nematoda: Trichostrongylidae) 84

————————. A note on *Protostrongylus stilesi* (Nematoda: Metastrongylidae) from the mountain sheep, *Ovis canadensis*, in Yellowstone National Park, Wyoming 84

———————— and LUCKER, JOHN T. New records of nematode parasites from deer in the United States 83

EWING, H. E. The rules of nomenclature as applied to the anopluran genus *Pedicinus* Gervais 67

————————. Two new pre-Columbian records of the American head louse, *Pediculus humanus americanus* 67

GIOVANNOLA, ARNALDO. *Plasmodium immaculatum* (Grassi and Feletti, 1892) Schaudinn, 1902, the correct name for the parasite causing malignant tertian malaria 90

HARWOOD, PAUL D. *Maculifer chandleri*, n. sp. (Allocreadiidae), a trematode from Texas catfish 75

HORSFALL, MARGERY W. Observations on the life history of *Macravestibulum obtusicaudum* Mackin, 1930 (Trematoda: Pronocephalidae) 78

HULL, J. B., and DOVE, W. E. Sand fly control in mangrove marshes 69

JELLISON, WM. L. *Cephenomyia pratti* (Diptera: Oestridae) reared from blacktailed deer 69

JONES, MYRNA F. The cestode *Hymenolepis microps* (Hymenolepididae) in ruffed grouse (*Bonasa umbellus*) 92

KRULL, WENDELL H. A note on the life history of *Echinostoma coalitum* Barker and Beaver, 1915 (Trematoda: Echinostomatidae) 76

————————. *Glaphyrostomum mcintoshi*, n. sp. (Trematoda: Brachylaemidae), with notes on its life history 77

MACY, RALPH W. A new trematode, *Limatulum gastroides* (Lecithodendriidae), from the little brown bat, *Myotis lucifugus* 74

MCINTOSH, ALLEN. A progenetic metacercaria of a *Clinostomum* in a West Indian land snail 79

————————. New host records of parasites 80

PRICE, E. W. Descriptions of some heterophyid trematodes of the subfamily Centrocestinae 70

SHERMAN, GRACE W. The control of the root-knot nematode, *Heterodera marioni* (Cornu) (Anguillulinidae), on tuberoses by hot water and vapor heat 111

SKINKER, M. S. Miscellaneous notes on cestodes 68

STEINER, G. Opuscula miscellanea nematologica, II 104

THORNE, GERALD. Notes on free-living and plant-parasitic nematodes, II 96

WEHR, EVERETT E. A revised classification of the nematode superfamily Filarioidea 84

YAKIMOFF, W. L. A new coccidium, *Eimeria halli*, n. sp., in rats 81